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Connectivity and ICT integration in Canadian elementary and secondary schools: First results from the Information and Communications Technologies in Schools Survey, 2003-2004

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by Johanne Plante
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and
David Beattie
Industry Canada

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See Appendix D for a list of contributors.

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Table of Contents

Acknowledgements		4
Introduction		6
1.0	ICT infrastructure in Canadian schools	8
	1.1 Presence of computers	8
	1.2 Computer operating systems and processor speed	12
	1.3 Technical support	14
2.0	School connectivity	16
	2.1 Internet-connected computers	16
	2.2 Types of connections used to access the Internet	17
	2.3 Network systems	19
	2.4 Videoconferencing technology	19
3.0	Access to computers and software	21
	3.1 Location of computers	21
	3.2 Access to Internet-connected computers	21
	3.3 Access to software	22
	3.4 E-mail accounts	23
	3.5 Online courses	24
4.0	Teachers' skills and professional development	25
	4.1 Teachers' skills	25
	4.2 Strategies to help teachers learn how to use ICT	25
5.0	ICT Challenges in schools	27
6.0	Conclusion	29
	Appendix A – Methodology	31
	Appendix B – Concepts and definitions	35
	Appendix C – Tables	39
	Appendix D – List of contributors - Acknowledgements	54
Reference		57
Endnotes		59
Cumulative Index		60

Introduction

In Canada, education authorities and governments have recognized the importance of integrating information and communications technologies (ICT) into teaching and learning both to prepare students for today's economy and to make the most of new learning tools.

Over the past decade, considerable effort has been devoted to acquiring hardware and software for elementary and secondary schools, to connecting them to the Internet, and to helping educators improve their own ICT-related knowledge.

The Information and Communications Technologies in Schools Survey (ICTSS) was sent to principals to collect reliable, baseline data on connectivity and other aspects of ICT access in elementary and secondary schools across Canada. The survey was developed by the Government of Canada's SchoolNet Program, in cooperation with the SchoolNet National Advisory Board, and Statistics Canada.

In 2002, the Conference Board of Canada developed an analytical framework for measuring school connectivity and ICT integration (Conference Board of Canada 2002). Two elements of this analytical framework – infrastructure and reach – were central to the ICTSS. Infrastructure includes the different components of ICT that make up the underlying foundation of a connected school, such as the number of computers and their characteristics. Reach refers to the degree to which teachers and students have access to the ICT infrastructure.

This report, which presents the first results of the 2003/04 ICTSS, is based on the responses of nearly 6,700 elementary and secondary schools, which were weighted to represent 15,500 schools in Canada. The first section of the report presents a profile of the current ICT infrastructure in schools. It includes information on the number of computers available to students and teachers for educational purposes; their characteristics (i.e. desktops, laptops, operating systems and processor speeds); and the average amount of time devoted per computer each month for ICT technical support.

Section two offers a snapshot of school connectivity across the country. It looks at the number of Internet-connected computers available to students and teachers for educational purposes, the types of connections used to access the Internet, the proportion of schools with an intranet or a website, as well as the presence of videoconferencing technology.

The third section documents the access that students and teachers have to the available ICT infrastructure (computers, Internet-connected computers and software). The analysis examines the availability of computers outside of regular school hours, presence of e-mail accounts and online courses.

The fourth section explores several factors that may play a role in the integration of ICT in the classrooms. It summarizes the views of principals regarding

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the ability of teachers to use ICT effectively for learning purposes. This section also presents information on the strategies implemented by schools to help teachers learn how to use ICT.

Finally, section five gives an overview of the challenges perceived by principals in using ICT.

A description of the survey methodology can be found in Appendix A.

What is the Information and Communications Technologies in Schools Survey?

The purpose of ICTSS was to obtain benchmark data on the integration of Information and Communications Technologies (ICTs) in education. This survey provides a comprehensive measure of ICT infrastructure and access, and identifies access patterns in elementary and secondary schools across Canada.

Statistics Canada, in partnership with Industry Canada's SchoolNet program (the survey sponsor), conducted ICTSS in October 2003. SchoolNet works with Canadian learning partners – provincial and territorial governments, education associations, school boards, schools, teachers and students – to increase access to and integration of ICT into the learning environment. The goal is to develop an ICT-skilled population, capable of participating in today's economy (Treasury Board of Canada Secretariat 2002). Support to the survey initiative has also been provided by Library and Archives Canada.

SchoolNet's National Advisory Board (SNAB) recommended in 2001 that research be undertaken "on how to integrate ICT into learning", which would address "how learners learn best through networked methods, how teachers can make best use of those methods, how learning communities can be created and developed, and how learning models and environments are changing". This recommendation was based on an emerging consensus on the role of ICT in learning, a consensus forged among the territorial, provincial and federal orders of government along with several education associations. ICTSS represents the first step in responding to that recommendation by providing baseline data on the technological infrastructure available to schools.

The survey targeted all schools (15,500 schools) at the elementary and secondary levels, including public, private and federal institutions, as well as schools for the visual and hearing impaired. There were approximately 10,100 elementary schools, 3,400 secondary schools and 2,000 mixed elementary and secondary schools (schools offering a combination of elementary and secondary grade levels) in Canada in 2003/04.

This report does not cover First Nations' schools, which will be addressed in a separate analysis. This report is based on data collected for the 2003/04 school year from nearly 6,700 schools, which were weighted to represent 15,500 schools in Canada. Information was collected from October 2003 to January 2004 and refers to the 2003/04 school year. The survey respondents were the school principals who provided both the data available to them as well as their views on ICT. In some cases, however, principals may have consulted or involved others in their responses.

All specific statements of comparison made in this report have been tested for statistical significance at the 95 percent confidence level or better. It is important to note that many of the school characteristics used for independent analysis may also be related to each other. For example, enrolment size and school location are related, with urban schools typically being larger than rural schools. Similarly, enrolment size and school administration are related, with public schools typically being larger than private schools. Other relationships between variables may exist and should be considered in the interpretation of the data. In many cases in this report, factors associated with ICT integration are examined in isolation and the relationship among these factors is not explored.

1.0 ICT infrastructure in Canadian schools

According to a report published by the Organization for Economic Cooperation and Development (OECD 2001), many countries are making substantial investments in computers and Internet connections for schools. The aim is to provide high-quality learning and teaching, and to equip young people for the demands of modern society. To realize the full benefits of this investment in education technology it takes much more than installing the hardware and software. Still, it is critical that schools have the necessary infrastructure available if ICT is to be integrated into the learning environment. The following section presents a profile of the ICT infrastructure currently in Canadian elementary and secondary schools. Information is included on the number of computers available to students and teachers for educational purposes, their characteristics (i.e. desktops, laptops, operating systems and processor speeds), as well as the average amount of time devoted per computer each month for ICT technical support.

1.1 Presence of computers

Almost all principals reported that their schools used desktop computers or laptops for educational purposes such as activities directed towards lesson preparation, execution or evaluation during the 2003/04 school year. Less than 1% of the elementary and secondary schools in Canada were without computers. Some schools may have decided, for various reasons (e.g. religious beliefs, technical reasons or others), not to have such technology. Overall, it is estimated that more than one million computers were available for educational use in schools across the country. This represents an average of 72 computers per school (Table 1).

Catalogue no. 81-595-MIE2004017

Table 1

Average number of computers and students per school, school year 2003/04

	Instructional level of school			
	All schools	Elementary	Secondary	Mixed elementary and secondary
All schools				
Average number of computers	72	53	134	55
Average number of students	351	294	608	204
Student-to-computer ratio (median)	5.0	5.5	4.3	3.4
Small school				
Average number of computers	32	31	46	14
Average number of students	106	112	137	29
Student-to-computer ratio (median)	3.4	3.7	3.1	2.1
Medium school				
Average number of computers	65	53	117	40
Average number of students	301	273	490	123
Student-to-computer ratio (median)	5.0	5.5	4.6	3.1
Large school				
Average number of computers	112	74	227	104
Average number of students	629	487	1145	452
Student-to-computer ratio (median)	6.3	6.9	5.1	4.6

Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

Not surprisingly, the number of computers used for educational purposes varied by the instructional level of the school (elementary or secondary), as well as the size of the school. For definitions of instructional level and size of school, please refer to text box. On average, the larger the school, the more computers there are. Secondary schools, which are generally larger in size than elementary schools, also have more computers.

Instructional level and size of school

Instructional level of the school: Elementary and secondary schools in Canada have been classed as ***elementary*** if they provide Grade 6 and under or a majority of elementary grades; ***secondary***, if they offer Grade 7 and over or a majority of secondary grades; and ***mixed elementary and secondary*** if they offer a combination of elementary and secondary grades.

Size of school is established based on the distribution of the number of students enrolled in elementary, secondary and mixed elementary and secondary schools. Size of school is given as follows:

	Elementary school	Secondary school	Mixed elementary and secondary school
Small school	Less than 200 students	Less than 300 students	Less than 60 students
Medium school	200 to 350 students	300 to 700 students	60 to 200 students
Large school	More than 350 students	More than 700 students	More than 200 students

Please refer to Appendix B for a more detailed description of school characteristics.

The student-to-computer ratio, that is, the number of students per computer in a school, is often used as a reference point for measuring the availability of computers. The student-to-computer ratio by itself does not convey information about the actual functionality and use of the equipment.

Median student-to-computer ratio

To better explain how computer availability may vary between schools and provinces, the median of the ratio is used in this analysis. Unlike means, which may be influenced by higher values, median student-to-computer ratio indicate the typical number of students per computer, with half of the schools having more students per computer and half having less. For example, a *"median"* student-to-computer ratio of 5 means that 50 per cent of schools had 5 students or less per computer. Ratios of students to computers were also calculated separately for elementary, secondary and mixed elementary and secondary schools; for public and private schools; for schools in urban and rural areas; and for small, medium and large schools.

Elementary and secondary schools in Canada typically have five students to a computer

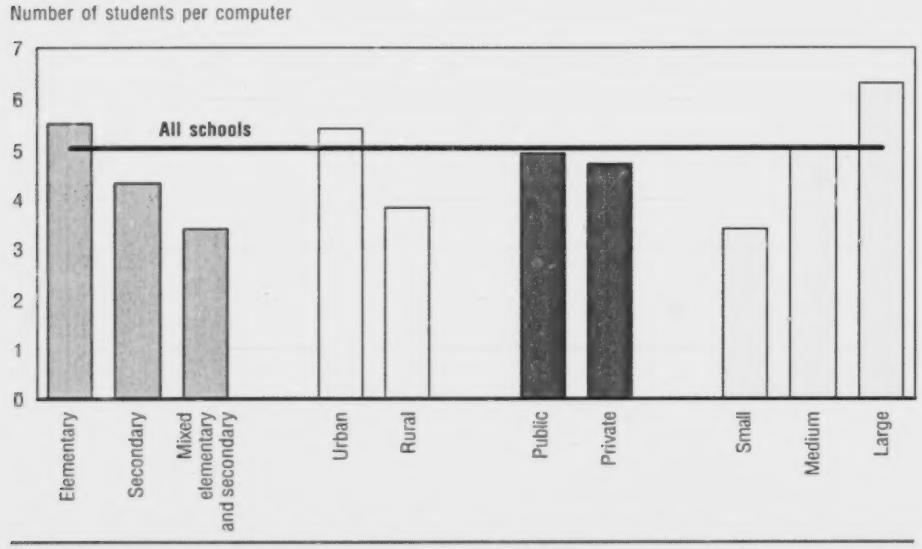
During the 2003/04 school year, the median number of students per computer in elementary and secondary schools in Canada was estimated at 5. These findings are consistent with data from the Programme for International Student Assessment (PISA), which revealed that a typical 15-year-old Canadian student in 2000 attended a school at which there was one computer for every six students. This ratio compares favourably to the OECD median of one computer for every 13 students. However, the ratio varies widely from one country to another. In Australia and the United States, there was one computer for every five students; there was one for every six students in New Zealand and Norway; and more than 20 students per computer in Germany, Greece, Mexico, Poland, Portugal and Spain (Statistics Canada 2002).

Differences in the student-to-computer ratio were observed by school characteristics (Chart 1). The typical number of students per computer in small schools was lower than in larger schools. Similarly, the ratio was lower in secondary schools than in elementary schools. The typical number of students per computer was lower in rural schools than in urban schools. However this difference is due to the fact that rural schools are generally smaller. There was no statistically significant difference between public and private schools. The Second International Technology in Education Survey (SITES), also indicated that computers were, in general, more readily available to students in higher grades (i.e. secondary) (Statistics Canada 2001).

Catalogue no. 81-595-MIE2004017

Chart 1

Student-to-computer ratio by school characteristics (median)



Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

School administration and location

School location: Rural schools are those located in rural areas and small towns (RST) as well as those within the rural fringes of a larger centre such as a census metropolitan area (CMA) (i.e. population of more than 100,000) or a census agglomeration (CA) (i.e. population of more than 10,000). Urban schools are those located in a CMA or CA, but not in the rural fringe.

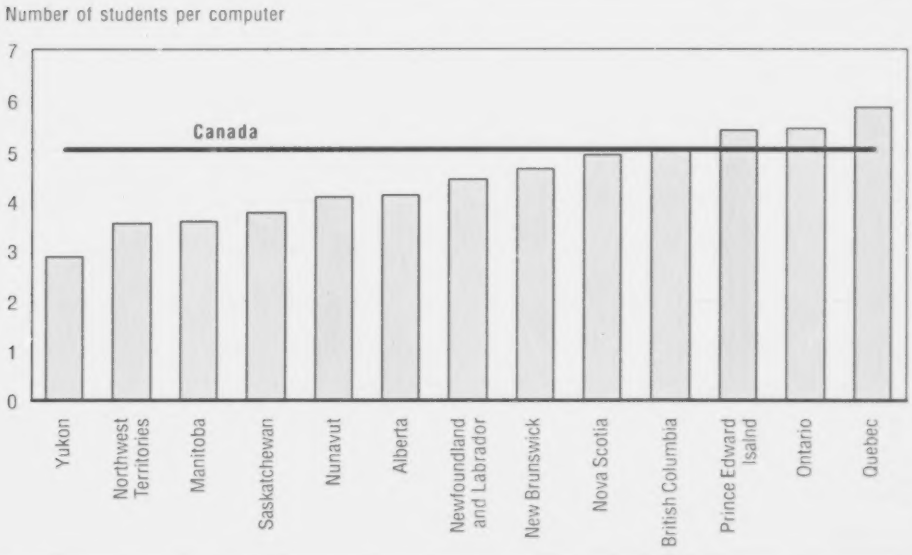
School administration: A school was classified as either ***public*** or ***private*** according to whether a public agency or a private entity had the ultimate power to make decisions concerning its affairs.

Please refer to Appendix B for a more detailed description of school characteristics.

The median number of students per computer varied widely among Canadian provinces and territories (Chart 2). The Yukon had the lowest ratio (i.e. fewer students per computer), while Prince Edward Island and the three largest provinces Quebec, Ontario and British Columbia had the highest number of students per computer.

Chart 2

Student-to-computer ratio by provinces/territories (median)



Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

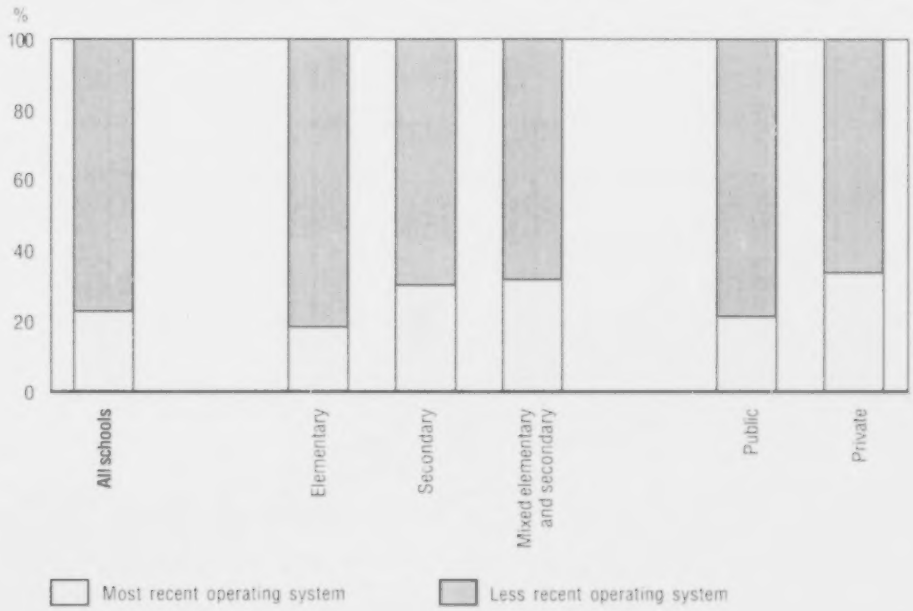
The vast majority of computers in elementary and secondary schools in 2003/04 were desktops (94%). The proportion of laptops and notebooks ranged between 5% and 7% for all school types, with the exception of private schools and mixed elementary and secondary schools, where the proportion of these portable devices was substantially higher (20% and 12%, respectively).

1.2 Computer operating systems and processor speed

To determine how up-to-date[1] school computers are, principals were asked to indicate the proportion of school computers running on various operating systems. An up-to-date operating system is one indicator of operating efficiency and capacity for application development (Franklin 2004). Only 23% of the elementary and secondary schools in Canada had the majority of their computers running on the most recent operating systems (Chart 3). However, this should not necessarily be considered a problem since many software applications available to students in schools may not necessarily require the most up-to-date operating system to operate efficiently. Secondary schools were more likely to have computers equipped with the most recent operating systems than elementary schools. Similarly, private schools were more up-to-date than public schools.

Chart 3

Proportion of schools with the majority of their computers running on the most recent operating systems



Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

Computers with medium processor speed are most common among elementary and secondary schools

Computer processor speed[2] is one of many factors that can be used to assess the quality of the infrastructure currently available in schools. In general, a higher processor speed allows for a wider range of computer use and applications and quicker response times.

Just over half (54%) of the computers in elementary and secondary schools were equipped with medium processor speed (i.e. 233 MHz to 1.4 GHz) (Chart 4). Overall, the proportion of computers with low processor speed (i.e. 66-233 MHz) was greater, at 29%, than the proportion with high processor speed (i.e. 1.3-3.8 GHz) (16%).

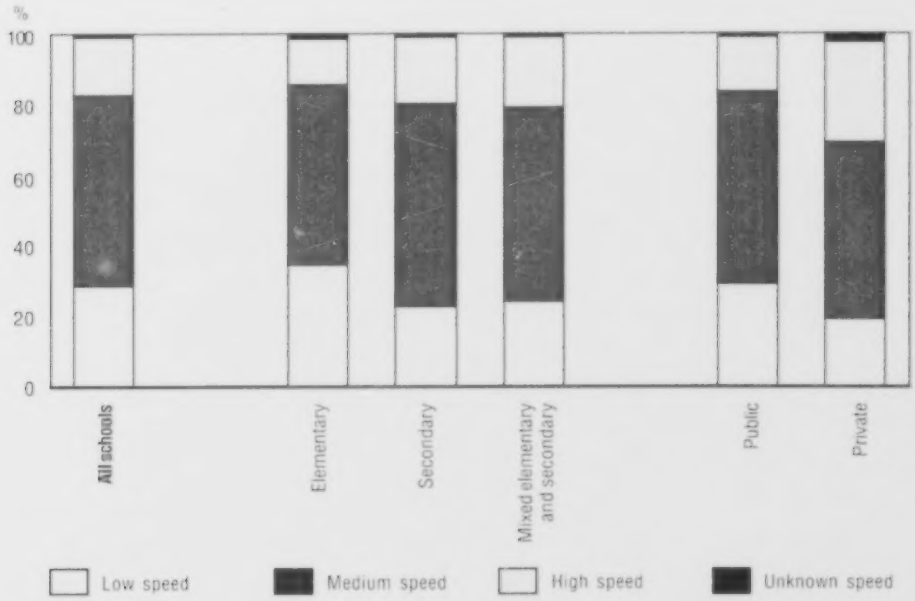
Private schools had the largest proportion of computers with high processor speed and the most recent operating systems

While computers with medium processor speeds were the most common for all school types, private secondary schools were the only group of schools which were more likely to have computers with high processor speed than with low processor speed. In fact, the proportion of computers with high processor speed in private secondary schools (40%) was about twice the proportion of such computers in their

public counterparts (17%) (data not shown). Small elementary schools, on the other hand, were more likely to have low processor speed computers than larger elementary schools and any secondary schools (data not shown). No marked differences in processor speed were observed between secondary schools located in urban and rural areas (data not shown).

Chart 4

Proportion of computers by processor speed



Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

1.3 Technical support

In order to sustain quality use, the initial installation of ICT needs to be followed by ongoing maintenance and technical support (fixing ICT problems and answering requests from users). Naturally, the amount of technical support required depends on the number of computers, the number and type of applications and the intensity of use.

Each month, just over 12 minutes per computer were dedicated to ICT maintenance or support in Canadian schools

Across all schools, slightly more than 12 minutes per computer was spent on ICT technical support each month. The median amount of ICT technical support time per computer increased with processor speed. This may seem unusual as one might expect older computers to require more support or maintenance than more recent ones. However, it may be that the number of applications and the intensity of use of

higher-end computers affect the amount of ICT technical time required for support, upgrades and maintenance. Further, it may be that the presence of higher-end computers reflects the overall ICT environments in these schools (i.e. schools with budget for higher-end computers may also have larger budgets for ICT technical support). ICTSS results showed that while slightly less than 16 minutes of technical time per computer per month were dedicated in schools where the majority of computers had "high processor speed", only 11 minutes were reported in schools where the majority of computers had "low processor speed" (Table 2).

Table 2

Monthly ICT technical support time per computer, school year 2003/04

	All schools	Elementary	Secondary	Mixed elementary and secondary	Public	Private
	Number of minutes (median)					
All computers	12	12	19	13	13	19
Majority of computers with:						
Low processor speed	11	11	15	11	11	3
Medium processor speed	14	13	19	16	13	27
High processor speed	16	13	27	16	15	31

Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

The median amount of monthly ICT technical support per computer was higher in secondary than in elementary schools and higher in private than in public schools (Table 2). As stated earlier, this may reflect the relative availability of technical support staff in these schools.

2.0 School connectivity

Substantial investments have been made over the past several years to connect elementary and secondary schools and classrooms to the Internet. Computers and Internet connections are now widespread in education. The following section provides a snapshot of school connectivity across the country, profiling the number of Internet-connected computers available to students and teachers for educational purposes, the types of connections used to access the Internet, the proportion of schools with an intranet or a website, as well as the presence of videoconferencing technology.

2.1 Internet-connected computers

Almost all elementary and secondary schools were connected to the Internet

During the 2003/04 school year, virtually all elementary and secondary schools were connected to the Internet. Only a small proportion of principals reported not having computers (less than 1%) or Internet connections (less than 3%). By comparison, nearly 55% of Canadian households in 2002 (Statistics Canada 2003a) and 78% of private sector enterprises in 2003 reported being connected to the Internet (Statistics Canada 2004). Results from the School Achievement Indicators Program (SAIP) showed that, in 2002, 93% of students aged 13 to 16 reported having a computer at home and 85% reported having Internet access (Council of Minister of Education Canada 2003). According to the Household Internet Use Survey, rates of Internet use vary substantially across family types, with children still a key factor. Single-family households with unmarried children under the age of 18 generally had the highest rate of Internet use (81%) in 2002 (Statistics Canada 2003b).

Connectivity has become widespread (Table 3). Within schools, nine out of ten computers were connected to the Internet and available to students. Again, Internet connectivity varies by instructional level of the school (i.e. elementary, secondary), size and school administration – the average number of connected computers available to students was higher in secondary schools than in elementary schools, in large schools than in small schools and in public schools than in private schools. Moreover, private elementary schools had slightly fewer computers connected to the Internet (73%) than elementary schools in the public school system (92%) (data not shown). The average number of Internet-connected computers available to students was lower in rural schools than in urban schools. However, this difference is due to the fact that rural schools are generally smaller.

Catalogue no. 81-595-MIE2004017

Table 3

Average number of Internet-connected computers and students per school, school year 2003/04

	Instructional level of school			
	All schools	Elementary	Secondary	Mixed elementary and secondary
All schools				
Average number of Internet-connected computers	66	48	128	49
Average number of students	351	294	608	204
Student-to-Internet-connected-computer ratio (median)	5.5	6.0	4.6	4.1
Small school				
Average number of Internet-connected computers	28	27	43	9
Average number of students	106	112	137	29
Student-to-Internet-connected-computer ratio (median)	3.9	4.2	3.5	3.2
Medium school				
Average number of Internet-connected computers	61	48	113	35
Average number of students	301	273	490	123
Student-to-Internet-connected-computer ratio (median)	5.4	5.9	4.7	3.4
Large school				
Average number of Internet-connected computers	105	68	216	98
Average number of students	629	487	1145	452
Student-to-Internet-connected-computer ratio (median)	6.8	7.6	5.4	5.1

Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

While the student-to-computer ratio in Canadian schools was 5 to 1, the median number of students per Internet-connected computer was only slightly higher at 5.5 to 1. This follows from the finding that most, but not all, computers in schools are Internet-connected.

2.2 Types of connections used to access the Internet

By improving access speed, or the rate at which information is transferred between networks and computers across the Internet, high-speed technologies are capable of sending and receiving large files several times faster than can be achieved using a dial-up Internet account (Veenhof, Neogi and van Tol 2003). The "always-on[3]" continuous Internet access feature is also important. Unlike dial-up connections, the Internet is always immediately available, and there is some evidence that this changes patterns of Internet use. Always-on connections tend to be more reliable and do not need to be re-connected with every use (Veenhof, Neogi and van Tol 2003).

Most schools used "always-on" connections to access the Internet

An overwhelming majority (86%) of schools used the "always-on" method to access the Internet, while only 9% used a regular dial-up telephone line with a modem (Table 4). The likelihood of having always-on access increased by size of the school. In addition, secondary schools were more likely to have always-on access than elementary schools. Among secondary schools, there were no significant differences in the use of always-on connections between urban and rural schools nor between private and public schools (data not shown). Among elementary schools, however,

urban schools and public schools were the most likely to have always-on connections (data not shown).

Table 4

Types of connections to the Internet, school year 2003/04

	All schools	Elementary	Secondary	Mixed elementary and secondary	Urban	Rural	Small	Medium	Large
	Percent of schools								
Dial-up access	**8.6**	**8.0**	**3.9**	**21.1**	**4.5**	**20.7**	**19.0**	**6.0**	**2.7**
Always-on	**85.8**	**84.2**	**93.2**	**79.6**	**89.3**	**75.6**	**77.1**	**87.9**	**90.8**
High-speed line (ISDN/DSL)	31.6	30.5	32.1	36.4	33.1	27.2	31.6	33.1	30.1
Optical fibre	22.8	23.6	29.1	6.6	26.9	11.1	13.5	20.7	32.5
Cable modem	15.3	16.7	12.4	13.6	17.2	9.8	14.7	16.7	14.5
T1 line	11.6	9.4	19.9	7.6	12.3	9.7	9.8	11.5	13.2
Fixed wireless	7.6	7.2	8.1	9.5	6.5	11.1	8.0	8.2	6.8
Satellite connection	4.9	4.2	2.5	13.7	2.4	12.4	6.8	5.9	2.5
Unknown type	**9.5**	**11.6**	**5.5**	**5.7**	**9.1**	**10.7**	**9.6**	**9.8**	**9.1**

Note: Percentages may not sum to one hundred since schools may have more than one type of Internet connection.

Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

Among the most popular methods to access the Internet were "high-speed line (ISDN/DSL)" (32%), followed by "optical fibre" (23%) and "cable modem" (15%). Others included "T1 line" (12%), "fixed wireless devices" (8%) and "satellite connection" (5%). By comparison, in 2001, nearly half (49%) of Canadian households that regularly used the Internet did so using a high-speed connection (Ellison 2003). In 2003, 66% of private sector enterprises that used the Internet connected using high-speed technology (Statistics Canada 2004). Please refer to appendix B for a more detailed description of the types of Internet connections and their characteristics.

Types of Internet connections

Different technologies have different performance over the Internet. Therefore, some technologies have a limitation to the applications that can be used (Erudium 2004). Broadband connectivity enables greater use of multi-media education applications integrating images, text, data and sound. Broadband includes the following types of connections: cable modem, high speed line (e.g. ISDN, DSL), T1 line, optical fibre and fixed wireless devices. Depending on speed and bandwidth, satellite connections can also be considered as broadband (Industry Canada 2004a).

Dial-up access, for example, is useful for e-mail, chat and modest browsing. Of course, only a single computer can be connected per phone line at a time. Not a lot of educational programs are designed for this level of access – typically they would either be on a CD-ROM or a LAN (CANARIE 2004).

Modest broadband (approximately 100 Kilobits per second (Kbps) to 1.5 Megabits per second (Mbps)) is useful for all the above and can be configured to more than one computer online at a time. These types of connections are useful for some interactive software packages and rich media downloading/streaming. Such technologies are acceptable for low-quality videoconferencing (CANARIE 2004).

Broadband (greater than 1.5 Mbps) can be used for near-broadcast quality point-to-point or multi-point videoconferencing and can absorb multiple users at a time downloading rich media (CANARIE 2004).

While there are many ways to connect to the Internet, not all types of connections are available in every geographical area. The selection of a type of connection may, in fact, be limited to what local providers can offer (Microsoft 2004). ICTSS results show that the method of accessing the Internet varies according to the school location, its size and its instructional level. Urban schools, for example, were more likely to use "cable modem" and "optical fibre" than their rural counterparts. Private schools, on the other hand, reported using "high-speed line (ISDN/DSL)" in larger proportion than public schools.

Just over 20% of rural schools are still using "dial-up" connections to access the Internet compared with only 5% for their urban counterparts. Rural schools were also more likely to use "fixed wireless devices" and "satellite connection" than urban schools. Satellite connection is sometimes the only "high speed" method of accessing the Internet available for schools in isolated and remote areas (e.g. northern, rural and remote communities) (Industry Canada 2004b).

2.3 Network systems

The majority of schools (76%) have an intranet (i.e. networks that connect computers within schools). Like the Internet itself, intranets are used to share information. Secure intranets are now the fastest growing segment of the Internet because they are much less expensive to build and manage than private networks based on proprietary protocols (Statistics Canada 2003c). Half of the elementary and secondary schools in Canada had an intranet that was "internal to the school jurisdiction's network" (i.e. information stored in the intranet can be accessed by students and teachers from schools within the same school board).

Nearly three-quarters (74%) of elementary and secondary schools in Canada had a website during the 2003/04 school year. Half of the schools reported having a formal corporate/administrative site for the school board/district/jurisdiction or school administrators, while just over 44% reported a non-administrative/informal site for educational purposes, used by teachers and/or students to share information. Large schools (84%) and secondary schools (86%) had the highest proportions of websites, compared with small schools (60%), medium schools (78%) and elementary schools (73%). In 2003, 34% of private sector enterprises had a website (Statistics Canada 2004).

2.4 Videoconferencing technology

Only a small proportion of schools have videoconferencing technology

Videoconferencing technology allows two or more people at different locations to see and hear each other at the same time (e.g. face-to-face meetings). This technology also offers the possibility for professional development and sharing of computer applications such as Internet pages, library catalogues, documents, or software (SBC Knowledge Network Explorer 2004). Results from the ICTSS showed that only 7% of the principals reported having such technology in their schools. The

technology involved in videoconferencing ranges from simple cameras and microphones to sophisticated and powerful networking equipment.

A higher proportion of secondary schools than elementary schools reported having videoconferencing technology (15% compared with 4%). Public secondary schools (16%) and rural secondary schools (21%) were more likely to have videoconferencing technology than their private (5%) and urban (14%) counterparts (data not shown).

In general, videoconferencing technologies require a high data transmission rate. Connectivity speed and bandwidth (i.e. the amount of data that can be transmitted in a given amount of time) determine the possible range of ICT uses and applications that can be used for educational purposes. Broadband[4] can help to reduce barriers of distance and isolation, enabling schools, particularly in rural and remote areas, to access educational applications (e.g. videoconferencing for distance education) previously beyond their reach (Industry Canada 2004a). Not surprisingly, of the schools with videoconferencing technologies, 85% reported having an "always-on" connection to access the Internet (i.e. cable modem, high-speed line, T1 line, optical fibre, fixed wireless or satellite connection), while 6% reported having "dial-up" connections (data not shown).

Catalogue no. 81-595-MIE2004017

3.0 Access to computers and software

Access to learning technologies in schools can open a wide range of opportunities for making learning and teaching more effective. Ideally, the educational use of computers and the Internet may provide an enriched learning environment for students, as well as a useful pedagogical resource for teachers. This section presents indicators of access to computers and software, as reported by school principals. Whether it is the availability or location of computers, or the availability of software, access to ICT is a critical necessity to the use of ICT.

3.1 Location of computers

Overall, about 45% of the computers in elementary and secondary schools in Canada were located in computer labs and another 41% were located in classrooms. Libraries and other locations shared the remaining number of computers with about 7% respectively. In secondary schools, over half the computers (55%) were located in computer labs, while classrooms are the preferred location for slightly more than half (51%) of the computers in elementary schools. This is not unexpected, as most teaching takes place within the same classroom at the elementary level, while courses at the secondary level are generally provided in many different instructional settings.

3.2 Access to Internet-connected computers

Access goes beyond identifying the number of computers and type of ICT equipment that is available. It also includes whether or not students can get to the technology (Conference Board of Canada 2002). Making the Internet accessible outside of regular school hours allows students who may not otherwise have access to the Internet to use this resource for school-related activities such as homework.

During the 2003/04 school year, nearly 61% of the principals reported that their schools provided students with *frequent access* (often to always) to Internet-connected computers *during school but outside of instructional hours* (lunch hours or breaks). About 87% of the principals in secondary schools and 64% in large schools gave their students *frequent access* to this technology during this period, compared with 50% of the principals in elementary schools and 58% in small schools.

Slightly less than 42% of elementary and secondary schools in Canada *frequently* made their computers available to students *before and/or after school*. Again the proportion of secondary (67%) and large schools (45%) giving *frequent access* to Internet-connected computers *before and/or after school* was higher than for elementary (30%) and small schools (40%). The proportion of private secondary schools (77%) giving *frequent access* to Internet-connected computers *before and/or after school* was higher than for their public counterparts (66%) (data not shown). However, no marked differences were observed between private and public elementary schools (data not shown).

Only 3% of the Canadian schools gave *frequent access* to Internet-connected computers on *weekends*. This is not surprising given that most schools are not open during the weekend. Small schools (5%) were more likely to provide *frequent access* to connected computers *on weekends* than larger schools (2%).

3.3 Access to software

Software applications have spread widely throughout Canadian schools. As shown by ICTSS results, the educational software accessible to students in schools consisted mainly of curriculum-embedded programs, Internet browsers and educational, drill and practice programs. Overall, the top five software applications available to students in schools were: word processing software, Internet browsers, educational, drill and practice programs, spreadsheet and database programs, and presentation software (Table 5).

The software applications available[5] to students in schools varied according to the size and the instructional level of the school. Not surprisingly, secondary schools generally provide students with access to a wider range of software applications than elementary schools. In addition, large schools provided access to a wider range of software than small schools (data not shown).

Table 5

Software access to students, school year 2003/04

	All schools	Elementary	Secondary	Mixed elementary and secondary
	Percent of schools			
Word processing software	97.1	96.7	99.5	94.8
Internet browsers	95.9	96.8	98.4	87.3
Educational, drill and practice programs	93.1	94.6	90.3	90.1
Spreadsheet and database programs	88.0	83.7	98.1	91.8
Presentation software	84.5	80.3	95.3	86.8
Graphic programs	81.1	81.6	83.6	73.9
Desktop publishing software	68.8	62.2	87.5	69.1
E-mail software	63.3	60.5	70.6	64.6
Simulation programs	50.4	47.9	57.9	49.7
Geographical Information Systems	28.3	24.3	44.1	21.2
Programming languages	28.1	13.7	65.0	34.5
Mathematical/statistical and business programs	22.9	13.6	49.2	23.9
Computer aided design (CAD) or computer aided manufacturing (CAM) programs	21.2	8.6	55.5	24.4

Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

According to school principals, "word processing software" was the application most often incorporated into teaching practices, with 78% of the principals reporting that it was used either "most of the time" or "always" (Table 6). This was followed by "Internet/Intranet" (34%) and "software for special needs students and/or remedial programs providing individualized learning" (29%).

Catalogue no. 81-595-MIE2004017

Table 6

Technology applications frequently incorporated into teaching practices, school year 2003/04

	All schools	Elementary	Secondary	Mixed elementary and secondary
	Percent of schools			
Use of word processing	78.2	77.3	82.1	75.7
Use of Internet/Intranet to disseminate information	34.4	32.5	40.5	33.5
Use of software for special needs students and/or remedial programs providing individualized learning	29.1	30.4	28.7	22.9
Use of Internet for online learning	28.8	27.0	32.7	30.5
Use of software for specific subject areas	28.3	28.1	30.9	25.0
Use of desktop publishing	24.1	23.5	26.1	23.6
Use of presentation software	21.4	16.0	35.5	23.8
Use of spreadsheets and database software for simple data manipulation and statistical analysis	15.3	10.3	27.4	19.5
Use of software supporting creative works	10.8	8.9	17.1	9.5

Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

Technology applications least frequently incorporated into teaching practices included "software supporting creative works" and "spreadsheets and database software for simple data manipulation and statistical analysis".

3.4 E-mail accounts

Schools provided e-mail accounts to a majority of their teachers but to few of their students

E-mail is one of the most common uses of the Internet today – in 2002, 95% of Canadian households that used the Internet from home used it for e-mail (Statistics Canada 2003b), while 74% of private sector enterprises used it in 2003 (Statistics Canada 2004). E-mail accounts in schools may be used in a number of ways. For example, teachers can correspond with other teachers, students and parents, while school boards may use e-mail as a form of communicating messages, notices, newsletters or announcements with staff or parent associations.

The majority of principals (nearly 84%) reported that *more than* 75% of their teachers have an e-mail account provided by either the school or the school board. However, this was the case for only 49% of private schools.

Despite the fact that 63% of principals reported students having access to e-mail software, most students were not provided with an e-mail account by the school or the school board. About three-quarters (77%) of the schools provided e-mail accounts to *less than* 25% of their students. Security and budgetary issues may represent some of the reasons for a school or a school board not to provide their students with an e-mail account. Furthermore, it is possible that students used school computers to access personal e-mail accounts such as "Hotmail" or "Yahoo".

3.5 Online courses

One school out of ten reported some students participating in online courses

Online courses can be an alternative when courses are not available at the school or the course cannot be offered due to a lack of resources or teachers. Some courses, for example, may be offered online to prepare students for postsecondary education particularly if certain prerequisites for university or college programs cannot be provided by the school.

Most of the electronic or online courses taken by students were developed by their own school board/district/jurisdiction/province or territory. More than a third (36%) of secondary schools had some of their students participating in online courses. This was the case for only 3% of elementary schools. Nearly 40% of rural secondary schools and 35% of their urban counterparts reported offering online courses to their students (data not shown).

4.0 Teachers' skills and professional development

Given the rapid changes in technology in recent years, the development of knowledge and skills for teachers is more important than ever. Education policymakers are increasingly aware of the need for more efficient professional development policies. Making teachers feel comfortable using ICT and encouraging them to integrate them into their lesson plans is a key objective of providing professional development to teachers (OECD 2004).

4.1 Teachers' skills

There is some evidence from other studies[6] that although teachers are using ICT in the learning environment, they do not feel that they are using them in the most effective and efficient ways (O'Haire 2003). From the ICTSS results, it would seem that this view is shared by school principals.

Not quite half of principals felt that most of their teachers were adequately prepared to effectively engage students in using ICT

According to school principals, most teachers possessed the required technical skills to use ICT for administrative purposes such as preparing report cards, taking attendance or recording grades, while fewer had the necessary qualifications to effectively engage students in using ICT to enhance their learning.

Three out of four (76%) principals reported that *more than* 75% of teachers possessed the required technical skills to use ICT for administrative purposes. Compared to public, large and urban schools, private, small and rural schools were less likely to report many teachers possessing such skills.

By contrast, not quite half (46%) of principals reported that *more than* 75% of teachers had the necessary qualifications to engage students in using ICT effectively. Private schools reported a lower proportion of teachers possessing such qualifications than did public schools as did secondary schools compared to elementary schools. Secondary school teachers are often subject specialists so it may be that ICT instruction is undertaken by particular teachers in secondary schools. Furthermore, ICT instruction in secondary schools may require more advanced skills. No marked differences were observed among the other school types.

4.2 Strategies to help teachers learn how to use ICT

ICTSS asked principals to report how much emphasis the school placed on different strategies to help teachers learn how to use ICT. With 25% of schools placing "*a lot*" of emphasis on mentoring activities with other teachers, this was the most popular

among the strategies (Table 7). Information-sharing with other staff members, personal learning activities, professional development and training sessions were also among the preferred strategies. These strategies were also among those most frequently cited as "*highly effective*" by principals.

Table 7

Strategies to help teacher learn how to use ICT, school year 2003/04

	"Some" to "a lot" of emphasis placed, by principal, on strategies to help teachers learn how to use ICT	"A lot" of emphasis placed, by principal, on strategies to help teachers learn how to use ICT	Strategy perceived as "highly effective" by principal
		Percent of schools	
Mentoring/coaching activities with other teachers or ICT professionals	69.0	25.1	37.5
Professional development	59.4	12.8	20.8
Information-sharing with other staff members / discussion forum	59.2	18.2	17.5
Training sessions	56.9	12.2	19.1
Personal-learning activities	55.7	14.6	20.7
Staff meetings	46.4	8.0	4.3
Organized after-school sessions	43.7	7.2	7.7
Informal online-learning	21.4	3.2	4.7
Summer programs	20.7	2.7	9.1
Courses online	13.4	1.4	4.6
Formal credit courses	12.7	1.2	11.8

Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

Formal credit courses and online courses were among the least popular with only about 1% of schools placing "*a lot*" of emphasis on these strategies.

Interestingly, 8% of principals placed "*a lot*" of emphasis on staff meetings but only 4% perceived those to be a "*highly effective*" strategy. Similarly, while formal credit courses were least likely to be heavily emphasized to help teachers learn how to use ICT, 12% of principals perceived them to be "*highly effective*".

Compared to larger schools and public schools, small schools and private schools were more likely to place *no* or *little* emphasis on the various strategies to help teachers learn how to use ICT (data not shown).

Catalogue no. 81-595-MIE2004012

5.0 ICT Challenges in schools

The penetration of ICT throughout the school system means that ICT management has become more complex, putting increased pressure on the school organization and operation. The ICTSS asked principals to indicate to what extent ICT-related issues, such as funding for technology, obtaining a sufficient number of computers and ensuring that computers and peripherals were up-to-date, were perceived as challenges to using ICT in their school.

Lack of financial capacity to purchase computers was a cause for concern for more than two thirds of principals

Financing ICT was a major area of concern for most principals. Nearly 67% of principals reported that "having sufficient funding for technology" was an *extensive challenge* to using ICT in their school (Table 8). Principals of large schools were more likely to report "financial ICT-related issues" than those in small and medium schools.

Related to this, "ensuring that computers and peripherals are up-to-date", "obtaining sufficient copies/licences of software for instructional purposes", "having enough training opportunities for teachers" and "obtaining sufficient number of computers" also placed high among the challenges.

Table 8

Extensive challenges to ICT use, school year 2003/04

	All schools	Small	Medium	Large
		Percent of schools		
Having sufficient funding for technology	66.8	65.1	65.8	69.3
Ensuring computers and peripherals are up to date	51.8	53.0	49.6	52.9
Obtaining sufficient copies/licences of software for instructional purposes	43.4	45.6	42.8	42.1
Having enough training opportunities for teachers	40.1	37.6	38.9	43.3
Obtaining sufficient number of computers	39.3	38.3	37.7	41.7

Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada.

Only a few principals (about 10%) considered "obtaining software in the language of instruction", "ensuring source of power is dependable" or "existence of a jurisdiction or province-wide regulation or licensing agreement that prohibits or prevents use of other software" as *extensive challenges* to using ICT.

More than nine out of ten principals (92%) either *slightly agreed* or *strongly agreed* that "ICT is worth the investment". More than 90% of them also *slightly or strongly agreed* with the following statements:

- ICT allows teachers to broaden and enrich the curriculum (96%);
- Overall, ICT enables the curriculum to be more challenging and enriching (93%);
- ICT enables students to go beyond the prescribed curriculum, thereby facilitating an increased knowledge base (92%) (data not shown).

Catalogue no. 81-595-MIE2004017

6.0 Conclusion

The 2003/04 Information and Communications Technologies in Schools Survey (ICTSS) collected information from principals to assess connectivity and ICT integration in elementary and secondary schools in Canada.

According to ICTSS, the foundations of ICT are present in the schools. Virtually all elementary and secondary schools in Canada had computers and were connected to the Internet. Overall, it is estimated that more than one million computers were available to students and teachers during the 2003/04 school year. About nine computers out of ten were connected to the Internet. Not surprisingly, the number of computers used for educational purposes varied by the instructional level of the school (i.e. elementary or secondary), and the size of the school. On average, the number of computers increased with school size. Moreover, secondary schools have more computers than elementary schools, since secondary schools are generally larger in size.

Computers are available for teachers and students use. With more than one million computers for 5.3 million students, the median number of students per computer in elementary and secondary schools in Canada was estimated at 5. The median student-to-Internet-connected computer ratio was only slightly higher with 5.5 students per computer. The typical number of students per computer was lower in small schools than in larger schools and in secondary schools than in elementary schools.

School computers are aging. Just under one-quarter of the elementary and secondary schools in Canada had the majority of their computers running on the most recent operating systems. Furthermore, more than half of school computers were equipped with medium processor speed, nearly a third of them had low processor speed. However, this should not necessarily be considered a problem since many software applications available to students in schools may not necessarily require the most up-to-date operating system to operate efficiently. Elementary schools (especially the small ones) were more likely to have low processor speed computers compared with secondary schools. Secondary and private schools, on the other hand, showed a higher proportion of computers equipped with high processor speed than their elementary and public counterparts.

While most schools are using "always-on" connections to access the Internet, these types of connections are not available in every geographical area. This may explain why slightly more than 20% of rural schools are still using "dial-up" connections to access the Internet compared with only 5% of their urban counterparts.

One of the many issues facing educational institutions today is how to successfully incorporate ICT into their curriculum. According to school principals, most teachers possessed the required technical skills to use ICT for preparing report

cards, taking attendance or recording grades, while fewer teachers had the necessary qualifications to engage students in using ICT effectively to enhance their learning.

Financial challenges figure among the most extensive barriers to ICT use. The growth in ICT facilities and their use means that ICT management has become more complex, putting increased pressure on the school organisation and operation. Nearly 67% of principals reported that "having sufficient funding for technology" was an *extensive challenge* to using ICT in their school. Related to this, "ensuring that computers and peripherals are up to date", "obtaining sufficient copies/licences of software for instructional purposes", "having enough training opportunities for teachers" and "obtaining sufficient number of computers" also placed high among the challenges.

Despite the perceived financial challenges, more than nine principals out of ten (92%) either *slightly agree* or *strongly agree* that "ICT is worth the investment".

ICTSS illustrates that elementary and secondary school systems are making substantial progress towards ICT integration: almost all schools now have both computers and Internet access. This report provides an overview of just some of the information available from ICTSS. Researchers interested in accessing additional data should refer to "How to obtain more information" at the front of this report.

Although this initial overview presents a great deal of new information, it leaves unexplored some potentially rich areas of future study such as regional differences in ICT infrastructure. The results of ICTSS also suggest a need for information on how ICT is integrated into teaching and learning practices as well as the extent to which the situation in the school system is comparable to that in the business or government sectors. Research in these areas would inform subsequent discussions on the impact of ICT on learning.

Catalogue no. 81-595-MIE2004017

Appendix A - Methodology

The Information and communications Technologies in Schools Survey (ICTSS)

Survey Concepts, Methodology and Data Quality

The following information should be used to ensure a clear understanding of the basic concepts that define the data provided in this report, of the underlying methodology of the Information and Communications Technologies in Schools Survey (ICTSS), and of key aspects of the data quality. This information will provide a better understanding of the strengths and limitations of the data, and of how they can be effectively used and analysed. The information may be of particular importance when making comparisons with data from other surveys or sources of information, and in drawing conclusions regarding differences between geographic areas and differences among sub-groups of the target population.

Target population

The target population for ICTSS is the set of all elementary and secondary schools in Canada, excluding continuing education/adult day schools, trade/vocational schools, language and cultural educational schools, home schools, community education centres and social service centres.

Survey design

ICTSS is a census of elementary and secondary schools across the country. The frame for the survey was derived based on Statistics Canada 2002 institution file, an administrative list updated yearly based on information gathered from public school boards and private schools. The observed population excluded schools that opened in 2003. Questionnaires were mailed out to all school principals on October 16th 2003, with the exclusion of First Nation schools for which a separate mail out will be administered. Respondents were offered the choice of answering the survey using either the paper version or an online application. Although the information was collected for virtual and distance learning schools, these schools were not included to derive estimates provided in this paper, as they represent a very small and unique population and their data was not comparable to other schools.

Data quality

Errors affecting a survey such as ICTSS can be random or they can occur systematically, in which case the estimates produced could be inaccurate even for

very large subpopulations. Proper planning was done for ICTSS to minimize errors. The collection process included initial contacts with provincial and territorial ministries, school boards, important agencies relating to the target school population, and the school principals. The questionnaires were tested on several occasions with school principals to ensure that the concepts were understood and relevant. The collection process was closely monitored to detect the presence of total non-response (i.e. when no questionnaire was returned) or partial non-response (i.e. when a questionnaire was returned but some questions were either not responded or were in conflict with other data provided by the respondent). Follow-up activities were in place to resolve these problems. The collection window was extended by one additional month (i.e. to the end of January 2004) to improve the response rates. Respondents were also offered, as a last resort, the possibility of answering only a subset of critical questions (i.e. questions 2, 3, 6, 15, 16 and 49).

An extensive analysis was performed on the quality of the responses received, as well as on the information available on the frame. This included an analysis of response rates for every question, the detection of outlying values for all numeric questions (e.g. number of computers), the detection of outlying values of relationships between numeric variables (e.g. student-to-computer ratio), the analysis of inconsistencies between frame and survey data (e.g. instructional level of school, size of school), and the analysis of data gathered under non-standard collection processes.

Non-response adjustments

Non-response is the major source of error for a survey such as ICTSS. As this class of errors is not generally random, it is important that it be prevented and also that a proper adjustment strategy be derived to compensate for the presence of systematic non-response patterns. Based on the analysis of the response rates, and operation constraints, the non-response patterns and the adjustment strategy were investigated assuming a two phase approach:

Phase 1: Focussed on only the critical questions for all respondents.

Phase 2: Focussed on all questions for only those respondents that answered beyond the critical questions.

Table 1 provides the sample and response rates distribution by province/territory for each phase. These figures are based on "usable" questionnaires (i.e. questionnaires with a minimum set of critical information), a subset of the 7,311 returned questionnaires or a rate of 47%.

These data sets were determined to have low partial response rates for the majority of the critical questions (Phase 1) and the majority of questions (Phase 2) respectively. Consequently, a weighting methodology based on key auxiliary information available on the frame (i.e. province/territory, language of school, instructional level of school, location of school, administration of school and size category) was adopted to correct for non-response. In each phase, the weight assigned to each school represents the number of other schools in the population with similar characteristics.

Catalogue no. 81-595-MIE2004017

Table 1

Response rates by province/territory

Province/territory	Questionnaires mailed out (in-scope schools only)	Phase 1 (All respondents – Critical Questions)		Phase 2 (Respondents that answered beyond critical questions)	
		Respondents	Rate (%)	Respondents	Rate (%)
Newfoundland and Labrador	331	198	59.8	187	56.5
Prince Edward Island	72	52	72.2	48	66.7
Nova Scotia	475	324	68.2	317	66.7
New Brunswick	366	288	78.7	279	76.2
Quebec	3,013	1,113	36.9	1,008	33.5
Ontario	5,634	1,976	35.1	1,821	32.3
Manitoba	820	444	54.1	391	47.7
Saskatchewan	808	441	54.6	396	49.0
Alberta	1,880	944	50.2	869	46.2
British Columbia	2,020	812	40.2	711	35.2
Yukon	29	24	82.8	24	82.8
Northwest Territories	52	37	71.2	35	67.3
Nunavut	41	23	56.1	17	41.5
Total	**15,541**	**6,676**	**43.0**	**6,103**	**39.3**

Non-response Variability Guidelines

The estimates from this survey are based on the subset of schools for which responses were obtained. Somewhat different figures might have been obtained if a complete census had been achieved under the same survey environment (e.g. same questionnaire, processing methods, etc.). The difference between the estimates obtained from the subset of respondents and the results from a complete count taken under similar survey conditions is called the non-response error of the estimate.

Although the exact non-response error of the estimate, as defined above, cannot be measured from the respondents' results alone, it is possible, by linking non-response to the related influencing factors described above, to estimate a statistical measure of the non-response error (i.e. the «standard error») from the data collected. Using the standard error, confidence intervals for estimates (ignoring the effects of other type of error) may be obtained under the assumption that the estimates are normally distributed about the true population value. The chances are about 68 times out of 100 that the difference between an estimate and the true population value would be less than one standard error, about 95 times out of 100 that the difference would be less than two standard errors, and virtually with certainty that the difference would be less than three standard errors. In order to determine whether two estimates were significantly different, confidence intervals were compared. If two confidence intervals overlapped there was no significant difference reported between the estimates. It should be noted that this formula is approximate because it estimates a confidence interval that is slightly higher than the 95% level of confidence. As a result, by using this conservative rule of thumb, there is a small risk that cases where the difference is significant (but very small), according to a 95% level of confidence, are not identified.

Because of the large variety of estimates that can be produced from a survey, the standard error is usually expressed relative to the estimate to which it pertains. The resulting measure, known as the coefficient of variation (CV) of an estimate is obtained by dividing the standard error of the estimate by the estimate itself and is expressed as a percentage of the estimate.

To produce CV estimates for this survey, standard error estimates were derived assuming an equal chance of response amongst schools having similar characteristics according to key auxiliary information available on the frame (province, language of school, instructional level of school, location of school, administration of school and size category). The methods adopted take into account adjustments made in producing the survey weights based on the key auxiliary information.

The application of these methods differed depending on whether the estimation was based only on critical questions (i.e. questions 2, 3, 6, 15, 16 and 49), or also on non-critical questions. When only critical questions were needed to produce an estimate, the standard error estimate was derived in one phase based on all survey respondents. However, when non-critical questions were also used, it was necessary to consider two phases. The first phase involved all respondents, and the second phase only the subset of respondents that answered beyond the critical questions. For example, the standard error for the average number of internet-connected computers per school (questions 15 and 16) was derived in one phase. However the standard error for the percentage of schools with word processing software(s) available to students (question 18) required a two-phase approach.

Most estimates derived from this survey involve ratios of two totals (for example, percentage of Internet-connected computers which is derived by calculating the ratio of the total number of Internet-connected computers over the total number of computers in the school). When a ratio of two totals is estimated, a linear function (called Taylor series linearization) of the two totals is used to approximate the standard error estimate of the ratio.

It should be noted that approximated CVs were derived for estimates of medians, based on CVs of corresponding population means. These approximations should generally be overestimating the proper CVs of these estimates, hence leading to conservative decision made based on these guidelines.

Before publishing any estimates, it was determined whether the estimate was releasable based on the following guidelines:

Non-response Variability Guidelines

Type of estimate	CV (in %)	Guidelines
1. Unqualified	0.0 – 16.5	Estimates were considered for general unrestricted release. Required no special notation.
2. Qualified	16.6 – 25.0	Estimates were considered for general unrestricted release although a warning cautioning users of the high sampling variability associated with the estimates was added. Such estimates are identified by '*'.
3. Restricted	25.1 – 33.3	Estimates were considered for general unrestricted release although a warning cautioning users of the very high sampling variability associated with the estimates was added. Such estimates are identified by '**'.
4. Not for release	33.4 or greater	Estimates were not released. In statistical tables such estimates were deleted and replaced by 'F'.

Appendix B – Concepts and definitions

1. Definitions of analysis variables

Number of schools, school year 2003/04

		All schools	Urban	Rural	Public	Private
All schools		**15,500**	**11,500**	**4,100**	**13,700**	**1,600**
Elementary	Small	3,200	1,700	1,600	2,600	500
	Medium	3,400	2,800	600	3,200	200
	Large	3,500	3,200	300	3,400	100
Secondary	Small	1,100	800	300	800	200
	Medium	1,200	1,000	200	1,000	100
	Large	1,200	1,100	100	1,100	0
Mixed elementary and secondary	Small	600	200	400	400	200
	Medium	700	200	500	500	200
	Large	700	400	300	500	100

Note: Rounded to the nearest hundred

Source: Information and Communications Technologies in Schools Survey 2003/04, Centre for Education Statistics, Statistics Canada

Instructional level of the school: Elementary, secondary and mixed elementary and secondary schools

Elementary and secondary schools in Canada have been classed as elementary if they provide Grade 6 and under or a majority of elementary grades; secondary, if they offer Grade 7 and over or a majority of secondary grades. Mixed elementary and secondary schools are schools offering a combination of elementary and secondary grades.

School location: Urban and rural

Rural schools are those located in rural areas and small towns (RST) as well as those within the rural fringes of a larger centre (census metropolitan areas (CMAs) or census agglomerations (CAs)). Urban schools are those located in a CMA or CA, but not in the rural fringe.

School administration: Public and private

A school was classified as either public or private according to whether a public agency or a private entity had the ultimate power to make decisions concerning its affairs. A school was classified as public if the school principal reported that it was: controlled and managed directly by a public education authority or agency; or controlled and managed either by a government agency directly or by a governing body (council, committee, etc.), most of whose members were either appointed by a public authority or elected by public franchise. A school was classified as private

if the school principal reported that it was controlled and managed by a non-governmental organisation (e.g., a church, a trade union or a business enterprise) or if its governing board consisted mostly of members not selected by a public agency.

School size: Small, medium and large

Size of school is established based on the distribution of the number of students enrolled in Elementary, Secondary and Mixed elementary and secondary schools. Schools for which their number of students fall in the bottom third (< 33.3%) of the distribution are defined as "**small-size school**". "**Medium-size schools**" are defined as those for which their number of students is falling between the bottom third (≥ 33.3%) and the top third (≤ 66.6%) of the distribution, while "**large-size schools**" represent those for which their number of students is falling at the top of the distribution (> 66.6%). Size of school is given as follows:

	Elementary school	Secondary school	Mixed elementary and secondary school
Small school	Less than 200 students	Less than 300 students	Less than 60 students
Medium school	200 to 350 students	300 to 700 students	60 to 200 students
Large school	More than 350 students	More than 700 students	More than 200 students

2. Types of Internet connections

Dial-up modem is the most common method of connecting to the Internet. Because dial-up modems run over normal telephone lines, they provide Internet access to virtually everyone. This type of connection is usually the slowest with 56 Kbps download and 36.6 Kbps upload, and the type and amount of the information that can be downloaded or uploaded is limited by the transmission quality of telephone lines. Web sites with animation, lots of graphics, or other detail may have trouble downloading at anything less than 28.8 Kbps.

Cable modem connects the user to the Internet through cable TV line. With 1.5 to 9 Mbps download and 16 to 640 Kbps upload, this type of connection is much faster than dial-up and gives the user a faster Internet content and graphics and a better streaming audio, video, and multimedia. Like Digital Subscriber Line (DSL), the user is connected all the time and the telephone line is available for calls.

Satellite Broadband. *Two-way* satellite broadband service transmits high-speed data via satellite to a dish antenna at the user's house. With a *one-way* satellite, the user needs a conventional modem and telephone link to an Internet service provider for uploads, but the newer two-way satellite systems allow the user to download and upload through the satellite dish. This type of connection is expensive but sometimes is the only fast option (e.g. speed of 400 Kbps to download and 33.6 Kbps to upload) for people who are beyond the service area of cable and DSL providers.

Catalogue no. 81-595-MIE2004017

Integrated Services Digital Network (ISDN) and T-lines are more common in business and commercial use.

Integrated Services Digital Network (ISDN). Digital connections have fewer errors in transmission, which means that a user can download graphics, Web pages, sound, and multimedia up to four times faster than with dial-up modems. A single ISDN line can handle up to eight devices, including a PC, telephone, fax, and video, and the user can have any two devices operating simultaneously. ISDN operates over standard telephone wires and fiberoptic circuits, meaning it is readily available. Speeds are around 64 to 128 Kbps, and costs include access, equipment, installation, and a router for multiple devices.

T-line. The T-carrier system is a direct link to the Internet. T-lines are very expensive and are usually used by Internet service providers to provide subscribers with Internet access or by businesses that want to set up point-to-point private networks.

Wireless is a telecommunications term in which electromagnetic waves (as opposed to wires) carry the signal over the communication path. Common examples of wireless equipment in use today include: Cellular phones and pagers, Cordless Computer Peripherals, Cordless Telephone Sets and Wireless Local Area Networks (LANs). Fixed wireless services at broadband rates involve the delivery and return of Internet traffic via radio transmissions from fixed towers. Each tower is hard wired to an Internet service provider and thus the Internet. To reach last mile clients, fixed wireless companies use existing cellular and PCS tower infrastructure but have to augment the existing network. This is because broadband, unlike voice, needs clear line-of-sight between the antennas. Fixed wireless in is often the only option for sparsely populated areas or where challenging terrain prohibits traditional wireline connections.

The following table compares different performances, and data transmission rate, corresponding to the technologies and transmission medium:

Types of connections	Transmission Medium	Technology	Theoretical rates
Dial-up modem	Copper wire (i.e. telephone lines)	Modem V90 (classic)	Reception: 56 Kbps Emission: 33,6 Kbps
Integrated Services Digital Network (ISDN)	Copper wire (i.e. telephone lines)	Modem ISDN 64, ISDN 128	64 or 128 Kbps in duplex mode
Asymmetric Digital Subscriber Line (ADSL)	Copper wire (i.e. telephone lines)	Modem ADSL	Reception: 1,5 to 9 Mbps Emission: 16 to 640 Kbps
Cable modem	TV Cable (CATV)	Cable modem	Reception: 10 Mbps Emission: 768 Kbps
Satellite broadband	Satellite	Satellite Antenna Modem V90 for emission	Reception: 400 Kbps Emission: 33,6 Kbps
Fixed wireless	Cellular telephony	Group Special Mobile (GSM)	14,4 Kbps
	Cellular telephony	G3 (Third Generation) (IMT 2000, UMTS)	144 Kbps up to 2 Mbps depending on the user movement speed
T-Lines	Coaxial cable	T1	1,5 Mbps in duplex mode
	Coaxial cable	T2	6 Mbps in duplex mode
	Coaxial cable	T3	45 Mbps in duplex mode
Optical fibre	Optical fibre	OC1	52 Mbps in duplex mode
	Optical fibre	OC3	155 Mbps in duplex mode
	Optical fibre	OC12	622 Mbps in duplex mode
	Optical fibre	OC24	1,2 Gbps in duplex mode

The term duplex refers to bi-directional transmission (i.e. emission and reception).

Kbps: kilobits per second.

Mbps: Megabits per second.

Gbps: Gigabits per second.

Source: Erudium 2004

Appendix C – Tables

The enclosed tables are based on the Information and Communications Technologies in Schools Survey, 2003/04. As a general rule, the data presented in this report show aggregates of total responses at the Canada level. Provincial and territorial data tables are available upon request (please refer to "How to obtain more information" at the front of this report).

Symbols and abbreviations

...	Not applicable
x	Suppressed to meet confidentiality requirements of the *Statistics Act*
*	Numbers marked with this symbol have a coefficient of variation between 16.6% and 25% and are less reliable than unmarked numbers
**	Numbers marked with this symbol have a coefficient of variation greater than 25% and less or equal to 33.3% and are very unreliable
F	Too unreliable to be published (coefficient of variation surpasses 33.3%)
0	Nul, zero or too small to be expressed

Coefficients of variation (CV) provide a measure of the reliability of the estimate, taking into account sampling variability. In order to estimate whether two values are statistically significantly different, the following formula can be applied to approximate a 95% confidence interval:

$Y \pm 2 (CV \times Y)/100$, where Y is the estimate

This approximate confidence interval gives a range within which the true value in the population is likely to fall. If two confidence intervals do not overlap, then there is a significant statistical difference between the two estimates. It should be noted that this formula is approximate because it estimates a confidence interval that is slightly higher than the 95% level of confidence. As a result, there is a small risk that a significant difference will be identified as insignificant.

For example, with a coefficient of variation of 16%, an estimate such as "30% of computers" would be accurate ±9.6%, 95 times out of 100 [±2(16x30)/100]. With a coefficient of variation of 33%, this estimate would be accurate ±19.8%, 95 times out of 100 [±2(33x30)/100].

In the enclosed tables, "Mixed" refers to schools offering a combination of elementary and secondary grades.

Table C-1

ICT infrastructure, school year 2003/04

		Instructional level of school			Location of school	
	All schools	Elementary	Secondary	Mixed	Urban	Rural
Number of schools	15,541	10,124	3,406	2,011	11,457	4,084
Average number of computers	71.6	53.2	134.2	54.7	79.5	49.1
Proportion of computers						
... by type						
Desktop	94.4	95.4	94.7	88.2	94.4	94.2
Laptops and Notebooks	5.6	4.6	5.4	11.8	5.6	5.8
... by Internet-connectivity						
Internet-connected	92.7	91.0	95.3	90.2	92.9	91.8
Non Internet-connected	7.3	9.0	4.8	9.8	7.1	8.2
... by processor speed[1]						
Low speed	28.5	34.5	22.6	24.4	27.8	31.8
Medium speed	54.3	51.1	57.8	54.9	55.0	51.3
High speed	16.1	12.9	18.8	19.7	16.1	15.9
Other speed	1.2	1.5	0.9*	1.0*	1.2	1.0
... by location						
Classrooms and portables	41.0	51.3	29.8	38.7	41.4	39.2
Computer labs	44.9	36.6	54.5	44.8	44.4	47.4
Libraries	7.5	7.2	8.1	6.8	7.6	7.0
Other location	6.6	5.0	7.7	9.7	6.6	6.4
Proportion of schools with ICT policy and plans	90.9	91.2	93.6	84.5	91.3	89.6
Policy for appropriate use of ICT by students	87.5	87.8	90.6	80.6	88.2	85.6
Policy for appropriate use of ICT by teachers	70.4	72.3	71.5	59.4	71.7	66.7
Technology plan for ICT acquisition, upgrading and replacement	66.7	68.2	67.2	58.2	68.2	62.4
Proportion of schools with videoconferencing technology	7.1	3.8	14.7	11.0	6.8	8.2
Proportion of schools with local area network (LAN)	96.9	97.5	98.9	90.5	97.5	94.9
Proportion of schools with at least half of their computers using the most recent[2] operating systems	22.8	18.3	30.5	31.9	23.1	22.0
Monthly ICT technical support hours per computer ratio (median)	0.2	0.2	0.3	0.2	0.2	0.2
Majority of computers – Low processor speed	0.2	0.2	0.3	0.2	0.2	0.2
Majority of computers – Medium processor speed	0.2	0.2	0.3	0.3*	0.2	0.2
Majority of computers – High processor speed	0.3	0.2	0.4	0.3**	0.3**	0.3

Table C-1 – concluded

ICT infrastructure, school year 2003/04

	All schools	Type of school		Size of school		
		Public	Private	Small	Medium	Large
Number of schools	15,541	13,740	1,624	4,955	5,266	5,320
Average number of computers	71.6	74.3	49.9	32.3	65.5	112.3
Proportion of computers						
... by type						
Desktop	94.4	95.6	79.9	93.5	94.7	94.5
Laptops and Notebooks	5.6	4.4	20.1	6.5	5.3	5.5
... by Internet-connectivity						
Internet-connected	92.7	93.4	85.0	88.1	93.0	93.8
Non Internet-connected	7.3	6.6	15.0	11.9	7.0	6.2
... by processor speed[1]						
Low speed	28.5	29.2	19.5	36.1	28.7	26.4
Medium speed	54.3	54.7	49.9	47.1	53.2	56.7
High speed	16.1	15.1	28.2	15.8	16.6	15.8
Other speed	1.2	1.1	F	1.0	1.4	1.1*
... by location						
Classrooms and portables	41.0	41.4	37.6	40.4	39.9	41.8
Computer labs	44.9	45.2	40.7	46.6	45.6	44.1
Libraries	7.5	7.6	5.8	6.3	7.9	7.6
Other location	6.6	5.8	15.9*	6.8	6.7	6.5
Proportion of schools with ICT policy and plans	90.9	95.4	56.1	82.6	93.8	95.5
Policy for appropriate use of ICT by students	87.5	92.3	49.9	78.3	90.6	92.9
Policy for appropriate use of ICT by teachers	70.4	76.2	28.2	63.2	71.4	76.1
Technology plan for ICT acquisition, upgrading and replacement	66.7	72.1	26.0	56.9	69.5	72.7
Proportion of schools with videoconferencing technology	7.1	7.5	4.3*	7.3	7.0	7.1
Proportion of schools with local area network (LAN)	96.9	98.2	86.3	91.7	99.3	99.3
Proportion of schools with at least half of their computers using the most recent[2] operating systems	22.8	21.3	33.9	22.0	24.0	22.3
Monthly ICT technical support hours per computer ratio (median)	0.2	0.2	0.3	0.2	0.2	0.2
Majority of computers – Low processor speed	0.2	0.2	0.0	0.1	0.2	0.2
Majority of computers – Medium processor speed	0.2	0.2	0.4	0.3	0.2	0.2
Majority of computers – High processor speed	0.3	0.2	0.5*	0.3*	0.3	0.2*

Notes:

1. Processor speeds are measured in Megahertz (MHz), with each MHz representing one million cycles per second (the number of times the computer processor is able to perform a task). Computers with low processor speed include those with processors in the range of 66-233 MHz (e.g. 486, Pentium® I). Computers with medium processor speed typically range in the area of 233 MHz all the way up to 1.4 GHz (Gigahertz) (e.g. Pentium® II/III, Apple™ G3). The most recent generation of processors on the market, classed as having high processor speed, are typically available in speeds of 1.3 GHz to 3.8 GHz and sometimes higher (e.g. Pentium® IV, Apple™ G5).
2. Computers with most recent operating systems were computers running with the latest version of operating systems (e.g. Windows™ NT/2000/XP, MAC™ OSX) at the time of the survey.

Source: Information and Communications Technologies in Schools Survey, 2003/2004.

Table C-2

Connectedness, school year 2003/04

	All schools	Instructional level of school			Location of school	
		Elementary	Secondary	Mixed	Urban	Rural
Proportion of schools with Internet-connected computers	97.7	98.2	99.1	92.4	98.1	96.5
Average number of Internet-connected computers	66.3	48.4	127.8	49.3	73.9	45.1
Proportion of Internet-connected computers						
... by type						
Desktop	94.6	95.7	94.8	87.7	94.6	94.3
Laptops and Notebooks	5.5	4.3	5.2	12.3	5.4	5.7
... by processor speed[1]						
Low speed	25.4	30.8	20.5	20.6	24.7	28.4
Medium speed	56.7	54.1	59.3	57.5	57.3	53.7
High speed	16.9	13.8	19.3	21.1	16.9	17.0
Other speed	1.1	1.3	0.9*	0.8*	1.1	0.9*
... by location						
Classrooms and portables	39.2	49.2	28.7	36.5	39.6	37.3
Computer labs	46.7	38.6	55.6	46.9	46.2	49.2
Libraries	7.8	7.5	8.3	7.0	7.9	7.2
Other location	6.4	4.8	7.4	9.6	6.4	6.2
Student to Internet-connected computer ratio (median)						
Canada	5.5	6.0	4.6	4.1	5.9	4.2
Newfoundland and Labrador	5.0	6.5	4.7	3.8	6.5	4.2
Prince Edward Island	5.6	5.6	5.7	5.9	6.5	5.4
Nova Scotia	5.1	6.2	4.7	4.1	5.5	4.4
New Brunswick	5.0	5.3	4.0	5.1	5.5	4.2
Quebec	6.5	6.4	6.9	5.3	7.0	4.6
Ontario	5.8	6.4	4.4	4.8	6.0	4.9
Manitoba	4.2	4.6	3.6	4.1	4.8	3.3
Saskatchewan	4.0	4.9	3.8	3.3	4.8	3.4
Alberta	4.5	5.0	4.1	4.2	4.7	3.5
British Columbia	5.6	6.0	5.0	3.8	6.0	3.6
Yukon	2.9	4.8	3.5	2.5	3.6	2.6
Northwest Territories	3.9	4.6	4.2	2.8	4.2	3.9
Nunavut	4.8	9.3	4.1	3.9	4.3	5.0
Proportion of schools by methods to access the Internet						
Dial-up access[2]	8.6	8.0	3.9	21.1	4.5	20.7
Always on[3]	85.8	84.2	93.2	79.6	89.3	75.6
Cable modem	15.3	16.7	12.4	13.6	17.2	9.8
High-speed line (ISDN/DSL) or Frame relay	31.6	30.5	32.1	36.4	33.1	27.2
T1 line	11.6	9.4	19.9	7.6	12.3	9.7
Optical fibre	22.8	23.6	29.1	6.6	26.9	11.1
Fixed wireless (terrestrial) devices	7.6	7.2	8.1	9.5	6.5	11.1
Satellite connection	4.9	4.2	2.5	13.7	2.4	12.4
Unknown type	9.5	11.6	5.5	5.7	9.1	10.7
Proportion of schools with Intranet	76.2	78.5	79.8	58.4	78.7	69.0
Internal to the school network	33.6	31.5	37.7	37.2	34.1	32.4
Internal to the school jurisdiction's network	49.5	55.0	47.8	24.5	53.2	38.9
Internal to the provincial/territorial education system's network	10.4	10.3	10.7	10.4	9.9	11.7

Catalogue no. 81-595-MIE2006017

Table C-2 – continued

Connectedness, school year 2003/04

		Instructional level of school			Location of school	
	All schools	Elementary	Secondary	Mixed	Urban	Rural
Proportion of schools with Website	74.3	72.7	85.8	63.0	78.2	63.3
Formal corporate/administrative site	49.5	48.0	57.8	42.8	52.9	39.8
Non-administrative/informal site	44.2	42.1	55.3	35.6	46.6	37.4
Proportion of schools by proportion of teachers or students with e-mail accounts						
Teachers						
Less than 25%	10.3	10.4	8.7	12.9	9.9	11.6
From 25% to 49%	2.9	2.6	3.0	4.3	2.6	3.7
From 50% to 74%	3.1	3.2	2.6	3.6*	2.9	3.6
75% or more	83.7	83.8	85.8	79.2	84.6	81.1
Students						
Less than 25%	76.8	80.7	68.9	70.5	77.2	75.8
From 25% to 49%	3.1	3.4	1.2*	4.8	2.8	3.8
From 50% to 74%	2.6	2.5	1.3*	5.2	2.4	3.1
75% or more	17.6	13.4	28.7	19.5	17.7	17.3
Proportion of schools with students participating in online courses	14.2	3.3	36.1	30.4	12.9	17.7
Through a virtual school	4.0	1.5	9.0	7.6	3.8	4.6
Through electronic or online courses developed by the school board/district/ jurisdiction/province or territory	8.5	1.3	24.2	17.7	7.6	11.2
Through electronic or online courses developed by another board/district/ jurisdiction/province or territory	4.3	1.0	10.1	10.7	3.7	6.2
Other	1.8	1.0	4.0	2.2*	1.9	1.7

		Type of school		Size of school		
	All schools	Public	Private	Small	Medium	Large
Proportion of schools with Internet-connected computers	97.7	99.2	85.4	94.1	98.9	99.7
Average number of Internet-connected computers	66.3	69.4	42.4	28.4	60.9	105.3
Proportion of Internet-connected computers						
... by type						
Desktop	94.6	95.8	77.1	93.4	94.8	94.7
Laptops and Notebooks	5.5	4.2	22.9	6.6	5.2	5.3
... by processor speed[1]						
Low speed	25.4	26.2	13.8	32.2	26.0	23.4
Medium speed	56.7	57.0	52.5	49.7	55.4	59.1
High speed	16.9	15.8	31.2	17.2	17.3	16.6
Other speed	1.1	1.0	F	0.9*	1.3	1.0*
... by location						
Classrooms and portables	39.2	39.5	34.9	37.3	38.0	40.2
Computer labs	46.7	47.1	40.8	49.4	47.3	45.7
Libraries	7.8	7.9	6.4	6.6	8.2	7.8
Other location	6.4	5.5	17.9*	6.8	6.5	6.2

Table C-2 – continued

Connectedness, school year 2003/04

	All schools	Type of school		Size of school		
		Public	Private	Small	Medium	Large
Student to Internet-connected computer ratio (median)						
Canada	5.5	5.4	6.7	3.9	5.4	6.8
Newfoundland and Labrador	5.0	5.1	3.3	3.4	5.1	6.7
Prince Edward Island	5.6	5.6	F	3.6	6.1	6.5
Nova Scotia	5.1	5.1	5.6*	4.3	5.7	4.8
New Brunswick	5.0	4.9	8.0**	3.5	5.6	6.3
Quebec	6.5	6.4	7.4	4.2	6.7	7.8
Ontario	5.8	5.8	6.0	4.3	5.6	6.9
Manitoba	4.2	4.2	5.8	3.3	4.5	6.0
Saskatchewan	4.0	4.0	3.4	3.4	4.0	5.4
Alberta	4.5	4.5	4.2*	3.7	4.5	5.2
British Columbia	5.6	5.4	7.1	3.8	5.6	6.8
Yukon	2.9	2.9	F	2.9	2.7	5.6
Northwest Territories	3.9	3.7	F	2.1	4.0	4.3
Nunavut	4.8	4.8	F	4.1	5.2	9.3
Proportion of schools by methods to access the Internet						
Dial-up access[2]	8.6	7.2	22.7	19.0	6.0	2.7
Always on[3]	85.8	86.4	79.4	77.1	87.9	90.8
Cable modem	15.3	14.7	20.3	14.7	16.7	14.5
High-speed line (ISDN/DSL) or Frame relay	31.6	29.7	49.0	31.6	33.1	30.1
T1 line	11.6	12.3	5.4	9.8	11.5	13.2
Optical fibre	22.8	24.9	4.0*	13.5	20.7	32.5
Fixed wireless (terrestrial) devices	7.6	7.9	4.9	8.0	8.2	6.8
Satellite connection	4.9	5.3	2.3**	6.8	5.9	2.5
Unknown type	9.5	10.4	1.3	9.6	9.8	9.1
Proportion of schools with Intranet	76.2	80.3	44.2	62.3	80.1	84.9
Internal to the school network	33.6	32.5	41.4	30.1	35.8	34.7
Internal to the school jurisdiction's network	49.5	55.5	3.6*	35.6	52.4	59.1
Internal to the provincial/territorial education system's network	10.4	11.5	1.8*	9.2	12.4	9.4
Proportion of schools with Website	74.3	75.2	67.2	60.0	77.8	84.1
Formal corporate/administrative site	49.5	49.6	49.0	40.8	51.7	55.2
Non-administrative/informal site	44.2	45.8	31.1	30.2	46.7	54.5
Proportion of schools by proportion of teachers or students with e-mail accounts						
Teachers						
Less than 25%	10.3	7.4	37.5	15.0	9.1	7.5
From 25% to 49%	2.9	2.3	8.4	3.9	3.5	1.5*
From 50% to 74%	3.1	2.8	5.6*	4.0	2.7	2.8
75% or more	83.7	87.6	48.5	77.1	84.8	88.3
Students						
Less than 25%	76.8	76.3	81.6	78.8	74.4	77.5
From 25% to 49%	3.1	3.1	2.8*	3.1	3.6	2.6
From 50% to 74%	2.6	2.5	2.8*	2.1	2.6	2.9
75% or more	17.6	18.1	12.7	16.0	19.4	17.1

Catalogue no. 81-595-MIE2004017

Table C-2 – concluded

Connectedness, school year 2003/04

	All schools	Type of school		Size of school		
		Public	Private	Small	Medium	Large
Proportion of schools with students participating in online courses	14.2	14.6	10.7	12.2	13.6	16.5
Through a virtual school	4.0	4.0	3.5*	2.9	3.7	5.2
Through electronic or online courses developed by the school board/district/ jurisdiction/province or territory	8.5	9.2	3.5*	7.1	8.0	10.4
Through electronic or online courses developed by another board/district/ jurisdiction/province or territory	4.3	4.4	3.2*	4.0	4.8	4.2
Other	1.8	1.8	1.7**	1.9	1.6	1.9

Notes:

1. Processor speeds are measured in Megahertz (MHz), with each MHz representing one million cycles per second (the number of times the computer processor is able to perform a task). Computers with low processor speed include those with processors in the range of 66-233 MHz (e.g. 486, Pentium® I). Computers with medium processor speed typically range in the area of 233 MHz all the way up to 1.4 GHz (Gigahertz) (e.g. Pentium® II/III, Apple™ G3). The most recent generation of processors on the market, classed as having high processor speed, are typically available in speeds of 1.3 GHz to 3.8 GHz and sometimes higher (e.g. Pentium® IV, Apple™ G5).
2. **Dial-up access** is defined as "Regular dial-up telephone line with a modem".
3. The method to access the Internet is said to be "**Always on**" when the method used by the school is one of the following: cable modem, high-speed line (ISDN/DSL) or Frame relay, T1 line, optical fibre, fixed wireless (terrestrial) devices or Satellite connection.

Source: Information and Communications Technologies in Schools Survey, 2003/2004.

Table C-3

Access to computers and software, school year 2003/04

	All schools	Instructional level of school			Location of school	
		Elementary	Secondary	Mixed	Urban	Rural
Student to computer ratio (median)						
Canada	5.0	5.5	4.3	3.4	5.4	3.8
Newfoundland and Labrador	4.4	5.7	4.5	3.4	6.1	3.7
Prince Edward Island	5.4	5.4	5.6	5.9	6.2	5.4
Nova Scotia	4.9	5.6	4.4	4.1	5.1	4.3
New Brunswick	4.6	5.2	3.8	3.9	5.3	3.9
Quebec	5.9	5.8	6.6	3.6	6.5	4.0
Ontario	5.4	5.8	4.1	4.2	5.6	4.6
Manitoba	3.6	4.1	3.4	2.7	4.3	2.6
Saskatchewan	3.7	4.4	3.7	3.1	4.4	3.0
Alberta	4.1	4.4	3.9	3.7	4.3	3.0
British Columbia	5.0	5.3	4.7	3.8	5.3	3.4
Yukon	2.9	3.6	3.5	2.5	3.5	2.6
Northwest Territories	3.5	4.3	3.9	2.8	3.6	3.5
Nunavut	4.1	7.7	4.0	3.6	4.1	4.1
Proportion of schools by type of software available to students						
Word processing software	97.1	96.7	99.5	94.8	97.1	97.0
Desktop publishing software	68.8	62.2	87.5	69.1	70.7	63.5
Presentation software	84.5	80.3	95.3	86.8	85.4	81.9
Spreadsheet and database programs	88.0	83.7	98.1	91.8	89.0	85.1
Programming languages	28.1	13.7	65.0	34.5	29.6	23.9
Graphic programs	81.1	81.6	83.6	73.9	83.4	74.4
Computer aided design (CAD) or computer aided manufacturing (CAM) programs	21.2	8.6	55.5	24.4	21.9	19.3
Mathematical/statistical and business programs	22.9	13.6	49.2	23.9	24.0	19.9
Educational, drill and practice programs	93.1	94.6	90.3	90.1	93.4	92.2
Simulation programs	50.4	47.9	57.9	49.7	51.5	47.1
Geographical Information Systems	28.3	24.3	44.1	21.2	30.5	22.0
Internet browsers	95.9	96.8	98.4	87.3	96.6	94.1
E-mail software	63.3	60.5	70.6	64.6	62.6	65.0
Other	52.7	48.9	64.7	46.6	54.8	45.7
Proportion of schools with Internet-connected computers available to students outside instructional hours						
Before and/or after school						
Desktops computers						
Frequent access[1]	41.7	30.1	67.0	56.3	41.9	41.0
Infrequent access	42.8	50.1	26.9	33.6	42.3	44.2
Never access	15.5	19.8	6.1	10.1	15.8	14.7
Laptops and Notebooks						
Frequent access	25.9	21.9	32.8	30.4	25.6	27.0
Infrequent access	29.4	28.3	30.8	32.3	30.0	27.2
Never access	44.7	49.9	36.4	37.3	44.4	45.7
During school						
Desktops computers						
Frequent access	60.8	50.1	86.7	70.5	61.1	60.1
Infrequent access	33.3	42.7	11.4	23.2	33.1	34.0
Never access	5.9	7.2	1.8	6.4	5.9	5.9
Laptops and Notebooks						
Frequent access	35.0	30.3	43.3	39.7	35.2	34.4
Infrequent access	28.0	28.4	27.6	27.2	27.7	29.2
Never access	36.9	41.2	29.1	33.2	37.1	36.4

Catalogue no. 81-595-MIE2004017

Table C-3 – continued

Access to computers and software, school year 2003/04

	All schools	Instructional level of school			Location of school	
		Elementary	Secondary	Mixed	Urban	Rural
Proportion of schools with Internet-connected computers available to students outside instructional hours						
On weekends						
Desktops computers						
Frequent access	2.8	1.9	3.3	6.6	2.2	4.7
Infrequent access	16.5	9.7	25.0	36.5	13.9	24.0
Never access	80.7	88.4	71.7	56.9	84.0	71.3
Laptops and Notebooks						
Frequent access	8.2	7.7	7.5	12.5	7.2	11.7
Infrequent access	17.2	12.2	25.8	23.1	16.2	20.8
Never access	74.7	80.2	66.7	64.5	76.6	67.5

	All schools	Type of school		Size of school		
		Public	Private	Small	Medium	Large
Student to computer ratio (median)						
Canada	5.0	4.9	4.7	3.4	5.0	6.3
Newfoundland and Labrador	4.4	4.4	3.3	2.9	4.5	6.5
Prince Edward Island	5.4	5.6	F	3.6	5.7	6.3
Nova Scotia	4.9	4.9	5.6*	4.2	5.5	4.6
New Brunswick	4.6	4.7	3.1	3.4	5.6	6.1
Quebec	5.9	5.8	6.8	3.8	6.2	7.1
Ontario	5.4	5.5	4.5	3.7	5.2	6.5
Manitoba	3.6	3.4	3.9	2.6	4.2	5.0
Saskatchewan	3.7	3.7	2.4	3.0	3.7	5.3
Alberta	4.1	4.1	3.0	3.1	4.0	4.8
British Columbia	5.0	4.9	5.3	3.5	5.1	6.1
Yukon	2.9	2.9	F	2.9	2.7	3.3
Northwest Territories	3.5	3.3	F	1.8	3.7	4.0
Nunavut	4.1	4.1	F	3.9	4.3	8.7
Proportion of schools by type of software available to students						
Word processing software	97.1	97.8	91.7	94.2	98.4	98.4
Desktop publishing software	68.8	70.2	58.0	55.3	72.2	77.5
Presentation software	84.5	85.8	73.9	73.1	87.9	91.3
Spreadsheet and database programs	88.0	88.5	83.3	78.7	91.6	92.6
Programming languages	28.1	27.5	33.1	19.0	28.1	36.3
Graphic programs	81.1	82.9	67.4	68.5	84.3	89.1
Computer aided design (CAD) or computer aided manufacturing (CAM) programs	21.2	22.4	12.5	11.7	21.5	29.5
Mathematical/statistical and business programs	22.9	23.5	18.7	16.0	22.0	29.9
Educational, drill and practice programs	93.1	94.3	82.7	88.1	94.7	96.1
Simulation programs	50.4	51.7	39.5	41.3	52.9	56.1
Geographical Information Systems	28.3	29.2	22.2	19.3	28.9	35.9
Internet browsers	95.9	97.8	81.3	89.2	98.5	99.4
E-mail software	63.3	64.1	57.2	61.6	64.8	63.2
Other	52.7	55.2	40.9	39.3	59.3	60.3

Table C-3 – concluded

Access to computers and software, school year 2003/04

	All schools	Type of school		Size of school		
		Public	Private	Small	Medium	Large
Proportion of schools with Internet-connected computers available to students outside instructional hours						
Before and/or after school						
Desktops computers						
Frequent access[1]	41.7	40.9	48.5	39.9	39.8	45.1
Infrequent access	42.8	43.7	35.0	40.0	45.4	42.4
Never access	15.5	15.4	16.6	20.1	14.8	12.5
Laptops and Notebooks						
Frequent access	25.9	25.0	36.5	26.9	25.1	25.9
Infrequent access	29.4	29.6	26.9	24.3	29.6	32.1
Never access	44.7	45.5	36.6	48.7	45.3	41.9
During school						
Desktops computers						
Frequent access	60.8	60.7	61.6	57.7	60.2	64.0
Infrequent access	33.3	33.8	29.3	33.4	35.1	31.6
Never access	5.9	5.5	9.2	8.9	4.7	4.5
Laptops and Notebooks						
Frequent access	35.0	34.4	44.9	35.0	33.4	36.5
Infrequent access	28.0	28.2	25.1	26.8	28.6	28.2
Never access	36.9	37.4	30.1	38.2	38.0	35.3
On weekends						
Desktops computers						
Frequent access	2.8	2.4	6.5	4.7	2.1	2.0
Infrequent access	16.5	15.5	26.1	18.2	16.6	15.0
Never access	80.7	82.1	67.4	77.1	81.3	83.0
Laptops and Notebooks						
Frequent access	8.2	7.6	13.6*	11.6	7.2	7.2
Infrequent access	17.2	16.5	26.0	17.9	15.5	18.2
Never access	74.7	75.8	60.5	70.5	77.4	74.6

Note:

1. **Frequency of access** is established as follow: Computers that were often to always available outside instructional hours were defined as "frequently accessible". Computers that were rarely available or available sometimes were defined as "infrequently accessible". "Never accessible" was assigned in the cases where principals reported that their computers were never available outside instructional hours.

Source: Information and Communications Technologies in Schools Survey, 2003/2004.

Catalogue no. 81-595-MIE2004017

Table C-4

Teacher skills and professional development, school year 2003/04

	All schools	Instructional level of school			Location of school	
		Elementary	Secondary	Mixed	Urban	Rural
Proportion of schools with teachers possessing the required technical skills to use ICT for administrative purposes						
Less than 25% of the teachers	14.6	13.2	13.1	24.4	12.9	19.6
From 25% to 49% of the teachers	3.3	3.2	2.8	4.9	2.9	4.5
From 50% to 74% of the teachers	6.4	5.9	5.6	10.5	5.5	9.1
75% of the teachers or more	75.6	77.7	78.6	60.3	78.7	66.9
Proportion of schools with teachers possessing the required technical skills to engage students in using ICT effectively						
Less than 25% of the teachers	18.9	16.9	19.1	28.3	18.1	21.2
From 25% to 49% of the teachers	11.4	10.5	15.1	9.6	11.8	10.1
From 50% to 74% of the teachers	23.5	23.3	26.9	18.8	24.1	21.9
75% of the teachers or more	46.2	49.3	39.0	43.4	46.0	46.8
Proportion of schools with technology applications frequently[1] incorporated into teaching practices						
Use of software for special needs students and/or remedial programs providing individualized learning	29.1	30.4	28.7	22.9	30.3	25.6
Use of software for specific subject areas	28.3	28.1	30.9	25.0	29.6	24.6
Use of spreadsheets and database software for simple data manipulation and statistical analysis	15.3	10.3	27.4	19.5	16.1	13.1
Use of word processing	78.2	77.3	82.1	75.7	78.6	77.0
Use of desktop publishing	24.1	23.5	26.1	23.6	25.0	21.6
Use of presentation software	21.4	16.0	35.5	23.8	22.2	19.1
Use of software supporting creative works	10.8	8.9	17.1	9.5	11.9	7.6
Use of Internet/Intranet to disseminate information	34.4	32.5	40.5	33.5	35.7	30.7
Use of Internet for online learning	28.8	27.0	32.7	30.5	29.5	26.8
Other	18.1	22.5*	x	x	22.2	x
Proportion of schools with strategies to help teachers learn how to use ICT						
Training sessions	12.2	13.0	11.1	9.9	13.0	9.9
Mentoring/coaching activities with other teachers or ICT professionals	25.1	25.5	25.4	22.8	27.4	18.7
Organized after-school sessions	7.2	7.8	5.9	6.0	8.2	4.1
Information-sharing with other staff members/ discussion forum	18.2	18.9	17.8	15.3	19.3	15.0
Staff meetings	8.0	8.3	6.8	8.2	8.5	6.4
Summer programs	2.7	3.2	1.7	2.1*	2.8	2.3
Courses online	1.4	1.6	1.0*	1.0*	1.5	1.3*
Informal online-learning	3.2	3.0	3.5	3.3	3.3	2.9
Formal credit courses	1.2	1.3	1.1*	F	1.3	1.0*
Personal-learning activities	14.6	14.9	13.8	14.0	14.7	14.2
Professional development	12.8	13.1	12.5	11.6	13.7	10.1

Table C-4 – continued

Teacher skills and professional development, school year 2003/04

	All schools	Instructional level of school			Location of school	
		Elementary	Secondary	Mixed	Urban	Rural
Proportion of schools where ICT learning is included for teacher development in the following subjects:						
Mathematics	40.4	37.8	48.5	39.2	41.6	36.8
Physics	7.7	0.7*	24.6	13.5	7.9	7.0
Chemistry	7.2	0.8	21.6	14.0	7.4	6.5
Biology/Life Science	10.0	3.4	25.9	15.2	10.4	8.8
Earth Science	9.0	7.2	13.7	9.5	9.2	8.2
General Science	15.1	11.3	24.4	18.2	16.0	12.6
French	18.7	18.7	22.0	13.0	19.1	17.4
English	30.6	28.1	36.4	33.0	31.1	29.0
Computer Education/Informatics	34.5	29.2	50.0	34.9	35.2	32.7
Other language(s)	2.8	1.5	5.6	4.4	3.4	1.1*
History	14.1	10.7	23.8	14.7	14.9	12.0
Accounting	4.6	0.5*	15.5	5.9	4.8	4.0
Geography	15.6	12.3	26.2	13.8	16.5	12.9
Business	5.1	0.5*	18.3	5.6	5.9	3.1
Social Studies	15.1	12.3	20.8	19.6	16.2	12.0
Economics	2.9	0.5*	8.9	4.5	3.3	1.8
Arts	12.9	10.5	20.6	11.9	14.1	9.4
Industrial Arts	6.4	1.3	20.7	7.5	6.5	6.3
Health and Physical Education	9.0	6.4	15.6	10.7	9.4	7.9
Vocational subjects	2.8	1.0	8.0	3.2	3.0	2.4
Religious Studies	4.1	3.1	6.6	4.7	4.7	2.2
Multidisciplinary projects or activities	16.5	16.6	17.6	14.0	16.5	16.7
Career studies	14.2	6.8	32.4	20.1	15.0	12.0
Other	9.4	10.1	8.0	8.6	9.8	8.3

	All schools	Type of school		Size of school		
		Public	Private	Small	Medium	Large
Proportion of schools with teachers possessing the required technical skills to use ICT for administrative purposes						
Less than 25% of the teachers	14.6	12.9	28.8	23.2	12.5	9
From 25% to 49% of the teachers	3.3	3.2	4.3	4.4	3.2	2.4
From 50% to 74% of the teachers	6.4	5.9	10.4	8.4	6.4	4.6
75% of the teachers or more	75.6	78.1	56.6	64.1	77.9	84
Proportion of schools with teachers possessing the required technical skills to engage students in using ICT effectively						
Less than 25% of the teachers	18.9	17.0	33.1	23.8	17.2	16
From 25% to 49% of the teachers	11.4	11.5	10.8	9.3	11.1	13.6
From 50% to 74% of the teachers	23.5	23.4	24.3	20.6	25.6	24.1
75% of the teachers or more	46.2	48.1	31.8	46.2	46.1	46.3
Proportion of schools with technology applications frequently† incorporated into teaching practices						
Use of software for special needs students and/or remedial programs providing individualized learning	29.1	31.0	14.1	24.5	29.5	32.6
Use of software for specific subject areas	28.3	29.2	21.3	24.3	29.5	30.8
Use of spreadsheets and database software for simple data manipulation and statistical analysis	15.3	15.2	16.8	10.9	15.0	19.7
Use of word processing	78.2	79.7	64.5	71.6	79.3	83

Catalogue no. 81-595-MIE2004017

Table C-4 – concluded

Teacher skills and professional development, school year 2003/04

	All schools	Type of school		Size of school		
		Public	Private	Small	Medium	Large
Proportion of schools with technology applications frequently[1] incorporated into teaching practices						
Use of desktop publishing	24.1	24.8	18.8	18.9	25.1	27.6
Use of presentation software	21.4	21.5	19.8	14.6	21.5	27.2
Use of software supporting creative works	10.8	10.9	10.4	8.0	10.4	13.7
Use of Internet/Intranet to disseminate information	34.4	35.7	24.0	27.1	36.6	38.7
Use of Internet for online learning	28.8	29.7	21.0	23.2	29.5	32.9
Other	18.1	23.4	x	9.3**	26.5*	26.4**
Proportion of schools with strategies to help teachers learn how to use ICT						
Training sessions	12.2	12.7	9.0	9.6	12.3	14.5
Mentoring/coaching activities with other teachers or ICT professionals	25.1	25.5	22.7	17.0	26.4	31.2
Organized after-school sessions	7.2	7.5	4.7	4.4	7.0	9.8
Information-sharing with other staff members/discussion forum	18.2	18.6	15.9	15.3	18.8	20.1
Staff meetings	8.0	7.9	9.1	7.1	7.8	8.9
Summer programs	2.7	2.7	2.5*	2.1	2.5	3.4
Courses online	1.4	1.5	x	1.6	1.3	1.3*
Informal online-learning	3.2	3.2	3.2*	3.4	3.4	2.7
Formal credit courses	1.2	1.2	1.7**	1.5	0.9*	1.2*
Personal-learning activities	14.6	15.0	11.9	13.5	14.2	15.9
Professional development	12.8	13.2	10.3	10.2	12.9	15
Proportion of schools where ICT learning is included for teacher development in the following subjects:						
Mathematics	40.4	41.9	28.5	32.9	42.9	44.7
Physics	7.7	7.0	12.8	4.8	7.1	10.9
Chemistry	7.2	6.6	11.8	4.5	6.9	9.9
Biology/Life Science	10.0	9.1	17.0	7.3	10.1	12.2
Earth Science	9.0	9.0	9.7	7.3	8.4	11
General Science	15.1	15.2	15.3	10.8	16.1	18.2
French	18.7	18.9	17.4	16.0	18.6	21.2
English	30.6	31.1	27.2	25.0	34.6	31.7
Computer Education/Informatics	34.5	35.0	31.2	28.4	36.7	38.1
Other language(s)	2.8	2.3	6.5	1.5	2.3	4.4
History	14.1	13.8	16.7	10.9	14.4	16.8
Accounting	4.6	4.5	5.8	2.7	4.5	6.3
Geography	15.6	15.4	17.7	12.2	15.6	18.6
Business	5.1	5.0	6.2	2.8	4.4	8.1
Social Studies	15.1	15.5	13.2	11.5	16.7	16.9
Economics	2.9	2.1	9.0	1.2*	2.7	4.6
Arts	12.9	12.9	12.8	8.7	13.3	16.3
Industrial Arts	6.4	7.0	1.6**	3.0	7.1	8.8
Health and Physical Education	9.0	9.0	9.8	6.8	9.2	10.8
Vocational subjects	2.8	3.1	1.0**	1.7	2.6	4.2
Religious Studies	4.1	3.6	8.1	3.3	4.1	4.8
Multidisciplinary projects or activities	16.5	17.1	12.7	13.8	16.9	18.7
Career studies	14.2	14.3	14.4	10.4	14.1	17.8
Other	9.4	9.8	6.6	7.7	10.8	9.5

Note:

1. Technology applications were defined as **frequently** incorporated into teaching practices when they were used "most of the time" or "always".

Source: Information and Communications Technologies in Schools Survey, 2003/2004.

Table C-5

Challenges in using ICT, school year 2003/04

	All schools	Instructional level of school			Location of school	
		Elementary	Secondary	Mixed	Urban	Rural
Proportion of schools with "extensive" challenges in using ICT						
Hardware						
Obtaining sufficient number of computers	39.3	40.5	39.6	32.4	40.6	35.6
Ensuring computers and peripherals are up to date	51.8	53.0	50.6	47.4	51.7	52.1
Software						
Obtaining software which is specific enough or adaptable	33.7	34.9	28.0	37.4	32.7	36.5
Obtaining sufficient copies/licences of software for instructional purposes	43.4	44.2	40.5	44.1	42.4	46.2
Obtaining software in the language of instruction	12.9	13.9	11.7	9.9	13.6	11.1
Instruction						
Integrating computers in classroom instruction practices	32.2	34.5	29.1	25.7	33.2	29.4
Having a sufficient number of teachers supervising students using computers	20.9	23.2	16.1	17.1	20.6	21.8
Maintaining sufficient level of ICT in all subjects for teachers to provide adequate level of instruction	38.3	40.4	35.9	31.0	38.5	37.6
Internet						
Integrating Internet into instruction of low-achieving students	21.1	23.4	17.1	16.1	21.3	20.8
Finding enough time in the school's or teachers' schedule for using the Internet	34.3	37.1	28.2	30.4	34.2	34.8
Having sufficient connections for simultaneous access to the Internet	24.0	25.7	17.6	26.6	21.7	30.4
Ensuring there is no information overload	23.2	25.4	17.7	21.8	23.5	22.5
Ensuring information obtained is of sufficient quality	26.5	28.4	22.4	24.2	26.4	26.9
Other						
Finding space to integrate computers into the classroom appropriately	25.1	26.6	23.5	19.8	26.1	22.4
Lack of knowledge, skills, interest and/or willingness of teachers to use computers	19.5	21.2	16.2	16.6	20.0	18.0
Obtaining adequate technical support/ assistance for operating, maintaining computers and/or solving technical problems	31.8	33.4	28.3	29.8	32.0	31.3
Having enough training opportunities for teachers	40.1	42.8	36.3	32.2	40.7	38.3
Ensuring ICT infrastructure is adequate for telecommunications	26.5	28.1	22.8	24.9	25.0	30.9
Ensuring ICT infrastructure has anti-theft and anti-vandalism mechanisms	15.5	14.6	18.0	15.4	15.9	14.4
Ensuring source of power is dependable	10.3	11.3	7.7	10.0	9.2	13.5
Existence of a jurisdiction or province-wide regulation or licensing agreement that prohibits or prevents use of other software	9.7	9.8	9.1	10.5	9.4	10.5
Finding enough time to integrate ICT into learning	36.7	39.2	32.7	30.1	36.9	35.9
Having sufficient funding for technology	66.8	68.0	65.4	62.8	67.8	63.9
Other	57.1	54.2	51.1*	74.6	53.3	66.1

Catalogue no. 81-595-MIE2004017

Table C-5 – concluded

Challenges in using ICT, school year 2003/04

	All schools	Type of school		Size of school		
		Public	Private	Small	Medium	Large
Proportion of schools with "extensive" challenges in using ICT						
Hardware						
Obtaining sufficient number of computers	39.3	39.9	33.7	38.3	37.7	41.7
Ensuring computers and peripherals are up to date	51.8	52.5	45.7	53.0	49.6	52.9
Software						
Obtaining software which is specific enough or adaptable	33.7	33.9	32.4	38.5	32.7	30.5
Obtaining sufficient copies/licences of software for instructional purposes	43.4	43.5	41.8	45.6	42.8	42.1
Obtaining software in the language of instruction	12.9	13.4	9.2	13.6	12.6	12.8
Instruction						
Integrating computers in classroom instruction practices	32.2	32.8	26.1	28.6	31.3	36.2
Having a sufficient number of teachers supervising students using computers	20.9	21.1	19.1	22.8	20.1	20.1
Maintaining sufficient level of ICT in all subjects for teachers to provide adequate level of instruction	38.3	38.7	33.8	38.5	37.8	38.4
Internet						
Integrating Internet into instruction of low-achieving students	21.1	21.4	19.3	22.8	20.8	20.1
Finding enough time in the school's or teachers' schedule for using the Internet	34.3	34.7	31.0	35.2	35.0	32.9
Having sufficient connections for simultaneous access to the Internet	24.0	23.7	26.8	30.2	21.0	21.7
Ensuring there is no information overload	23.2	23.4	21.2	24.4	22.3	23.1
Ensuring information obtained is of sufficient quality	26.5	26.5	26.6	29.4	24.7	26.0
Other						
Finding space to integrate computers into the classroom appropriately	25.1	25.2	23.5	22.8	24.7	27.5
Lack of knowledge, skills, interest and/or willingness of teachers to use computers	19.5	19.9	17.0	17.8	19.2	21.2
Obtaining adequate technical support/ assistance for operating, maintaining computers and/or solving technical problems	31.8	32.4	27.0	31.4	31.3	32.8
Having enough training opportunities for teachers	40.1	41.5	27.7	37.6	38.9	43.3
Ensuring ICT infrastructure is adequate for telecommunications	26.5	26.6	26.2	30.7	24.1	25.4
Ensuring ICT infrastructure has anti-theft and anti-vandalism mechanisms	15.5	15.0	20.0	16.3	13.6	16.6
Ensuring source of power is dependable	10.3	10.6	8.8	12.3	9.5	9.5
Existence of a jurisdiction or province-wide regulation or licensing agreement that prohibits or prevents use of other software	9.7	9.7	9.5	9.5	9.4	10.2
Finding enough time to integrate ICT into learning	36.7	37.7	27.0	34.3	37.3	38.0
Having sufficient funding for technology	66.8	67.2	63.3	65.1	65.8	69.3
Other	57.1	56.5	55.0*	58.8	51.5	60.4

Source: Information and Communications Technologies in Schools Survey, 2003/2004.

Appendix D – List of contributors - Acknowledgements

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Catalogue no. 81-595-MIE2004017

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Catalogue no. 81-595-MIE2004017

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Endnotes

1. For the purpose of this analysis, computers with most recent operating systems were computers running with the latest version of operating systems (e.g. Windows™ NT/2000/XP, MAC™ OSX) at the time of the survey. Computers reported under the "other" response category were grouped with the less recent operating systems.
2. Processor speeds are measured in Megahertz (MHz), with each MHz representing one million cycles per second (the number of times the computer processor is able to perform a task). Computers with low processor speed include those with processors in the range of 66-233 MHz (e.g. 486, Pentium® I). Computers with medium processor speed typically range in the area of 233 MHz all the way up to 1.4 GHz (Gigahertz) (e.g. Pentium® II/III, Apple™ G3). The most recent generation of processors on the market, classed as having high processor speed, are typically available in speeds of 1.3 GHz to 3.8 GHz and sometimes higher (e.g. Pentium® IV, Apple™ G5).
3. Always-on methods to access the Internet includes cable modem, high speed line such as Integrated Services Digital Network (ISDN) and Digital Subscriber Line (DSL), T1 line, optical fibre, fixed wireless devices and satellite connection.
4. Broadband comes from the words "broad bandwidth" and is used to describe a high-capacity, two-way link between an end user and access network suppliers capable of supporting full- motion, interactive video applications (Industry Canada 2004b).
5. For the purpose of this analysis, software was said to be available to students when principals reported that software was available to at least some students (i.e. some, many or all students).
6. In 2003, a survey on teacher use of ICT was conducted by Vector Research on behalf of the Canadian Teachers Federation (CTF). Telephone interviews were conducted from May 27th to June 5th with 880 teachers in publicly funded school boards across Canada. The sample was randomly drawn from lists provided by provincial teacher federations. The national poll was one part of a CTF study, An Investigation of the Integration of Information and Communication Technology into Canadian Schools and Classrooms, funded by Industry Canada's SchoolNet Program.

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